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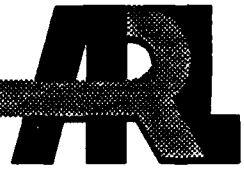

Characteristics of JAX Gun Propellant

Robert J. Lieb
Joseph M. Heimerl

ARL-TR-465 June 1994

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	June 1994	Final Jan 88 - Jan 94

4. TITLE AND SUBTITLE

Characteristics of JAX Gun Propellant

5. FUNDING NUMBERS

PR: 1L161102AH43

6. AUTHOR(S)

Robert J. Lieb and Joseph M. Heimerl

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army Research Laboratory
ATTN: AMSRL-WT-PA
Aberdeen Proving Ground, MD 21005-5066

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES)

US Army Research Laboratory
ATTN: AMSRL-OP-AP-L
Aberdeen Proving Ground, MD 21005-5066

10.SPONSORING/MONITORING AGENCY REPORT NUMBER

ARL-TR-465

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

To increase the performance of 120-mm kinetic energy tank rounds, propellant made by adding up to 30% ground RDX to JA2 (JAX) has been manufactured and tested. While the performance goals of the JAX were met, its response to shaped charge jet attack in several different vulnerability tests was much more violent than that of JA2 alone. This unexpected violent response of JAX propellants has been documented. In the attempt to understand the mechanism responsible for this response, the deposition of dry crystalline RDX on exposed JAX surfaces was discovered. This crystalline formation was detected during a routine morphological examination using a scanning electron microscope, and the crystals were identified by Fourier transform infrared (FTIR) surface Microreflectance. A wicking mechanism has been proposed to explain this phenomenon. Thermal, chemical, aging, and morphological investigations were performed to substantiate this mechanism. The information gathered indicates that the RDX deposition process occurs in all JAX propellant and may occur in other JAX-like materials. Since JAX undergoes continuous morphological change with temperature and time,
there are important safety implications for the storage and handling of these materials, as well as questions concerning their subsequent suitability for use in weapon systems. It was also found that standard safety tests do not indicate the presence of the deposited RDX. All of these findings are documented and the implications are discussed.

14. SUBJECT TERMS

JA2, RDX, gun propellants, JAX, vulnerability, mechanical, response, morphology

15. NUMBER OF PAGES

85

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAR

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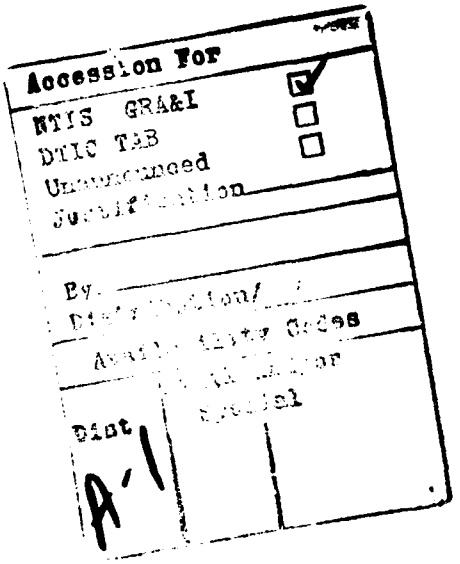

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ACKNOWLEDGMENTS

This report is the accumulation of many distinct items of information that were collected over a period of about 7 years.

We thank the following folks from whom we amassed the vulnerability information on the JAX propellants: N. Gerri's very early PrimaCord test results; D. Devynck's air blast data; O. Lyman's shock velocity test results; T. Adkins, G. Gibbons, D. Serrano and J. Watson who developed the impulse pendulum and staged compartment tests and accumulated the results; and G. Garcia who performed BLAKE calculations.

M. Leadore performed all mechanical properties testing of the propellants. C. Gillich used the scanning electron microscope to discover the white "powder" within the perforations of the JAX grains, and produced, cataloged, and performed initial analysis for the recent micrographs used in this study.

R. Pesce-Rodiriguez used her skill with the Fourier transform infrared (FTIR) microscope to determine that the "powder" seen on the JAX propellant surface was a nitramine. In addition, she performed the solubility experiments of RDX and HMX in DEGDN. We extend many thanks to her for allowing us to use her unpublished results. Thanks are also due to F. Robbins for allowing us to remark on his studies with PARAPLEX G59, and to W. J. Worrell and B. M. Riggleman of Hercules (Radford) for supplying information contained in Reference 21.

The reviewers, R. Frey, F. Robbins, and B. Strauss, are thanked for making this a more readable manuscript.

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1. INTRODUCTION

Methods have been and are being sought to increase the lethality of a kinetic energy (KE) tank round. One approach is to increase the rod's velocity by increasing the energy available to the round. This is most readily accomplished, at least in principle, by increasing the energy of the propellant.

The propellant of choice in several prior tank ammunition applications has been JA2. It is made from nitrocellulose (NC), nitroglycerine (NG), and diethylene glycol dinitrate (DEGDN) in relative amounts of roughly 60%, 15%, and 25%, respectively. JA2 has a nominal impetus of 1150 J/g, as computed from the BLAKE code.[1] To increase the energy, cyclotrimethylenetrinitramine (RDX) has been added to JA2 during manufacture.[2, 3] The computed increase in the impetus, flame temperature, and the chemical energy, which is the impetus divided by (γ - 1), is given in Table 1. The common, generic name for JA2 propellant with RDX added is *JAX*. A common name for a specific amount of RDX added to JA2, say B%, is *2RB*. For example, 10% RDX added is given the designation 2R10. This is the nomenclature used in Table 1.

JAX has been made with nominal RDX additions ranging from 6.5 to 30% by weight. The RDX used in the earlier manufacture of JAX was fluid energy milled and had particles with a mean diameter[2] of 7.5 μm. The more recent manufacture used nominal 4-μm recrystallized RDX from Dupont Corporation.[3] The JAX referred to in this report is generally the earlier manufactured material. For the same propellant formulation, more stick propellant than granular propellant can be placed into a fixed volume gun chamber; thus, the JAX had been made in both granular and partially cut stick (PcS) geometries. The sticks were kerfed, or cut part way through at selected linear intervals along the stick, to relieve the internal pressure when the propellant began burning.

Performance increases were realized.[2] However, the response of JAX to the unplanned stimulus of a shaped charge jet was violent, approaching, or, in some cases, perhaps sustaining a detonative event. Because JA2 itself usually just burns in such tests, the violent response was not anticipated. In addition, other propellants, e.g., XM39 and M43, have been formulated with several times the RDX loading of the JAXs and in similar tests, they responded less violently to the shaped charge

Table 1. BLAKE Computations for JA2 and Selected JAXs

Formula	Impetus J/g	Flame Temp K	Impetus/(γ -1) J/g
JA2	1153	3448	5130
2R6.5	1168	3489	5194
2R10	1175	3509	5225
2R12	1179	3520	5240
2R16	1187	3541	5273
2R17.5	1189	3548	5283
2R20	1194	3560	5302
2R30	1209	3602	5367

attacks.[4] Thus, the question is raised: what happens to the JA2 when the addition of even small amounts of RDX is observed to change the vulnerability response from burning to detonative?

In an effort to address this question, several test results are reviewed. First, the mechanical fracture response of JAX relative to JA2 is discussed. Second, the results of a number of vulnerability tests that demonstrate the different vulnerability responses of JA2 and JAX are reviewed. Third, JAX is characterized by the now standard propellant characterization techniques,[5] the results were not anticipated and their interpretation consumes the latter half of this report.

2. THE FRACTURE RESPONSE OF JAX

2.1 Mechanical Response Testing.

Three lots of JAX propellant were produced in 1985 and had fracture response evaluations performed with methods that were in use during that period.[6, 7, 8, 9] The mechanical parameters reported are the results of those tests. These results have been shown to agree with results gathered from improved procedures and equipment subsequently developed to expand the scope and quality of fracture response measurement. This section is based on an unpublished technology transfer report.[10]

Two methods of fracture evaluation were used to characterize the JAX materials. The first was the drop weight mechanical properties test (DWMPT)[6, 7] that provides high-rate, uniaxial, compressive loading to individual grains from which the propellant modulus, failure stress, failure strain, etc., are determined at various temperatures (-50° C to 60° C). These parameters are illustrated in Figure 1. This test characterized the uniaxial response of standard test grains and can indicate fracture response differences in materials. The second method was the gas gun impact test (GGIT)[8, 9] with surface area analysis performed using the damaged grains. In this latter test, a single grain is damaged by a single impact at a controlled velocity, orientation, and temperature. After several grains are damaged, the grain and any of its shards are collected and burned in a small closed bomb. The pressure-time data is reduced using burning rates established for undamaged grains. From this, a surface area vs fraction burned profile is generated that reveals the nature and degree of the fracture damage suffered during impact, as shown in Figure 2. The fracture susceptibility is quantified by summing the difference between the damaged-grain fracture profile and the profile predicted for the undamaged grain, which is represented by the shaded area in the plot. These two procedures provide mechanical and fracture response information that can be used to indicate propellant fracture susceptibility.

DWMPT and GGIT procedures were performed using JAX propellant under conditions similar to those used for previously tested JA2 propellant. DWMPT procedures were conducted at 20, -10, and -32° C at a strain rate of about 200 s^{-1}. Modulus, failure stress, and failure strain vs temperature results are shown in Figure 3. The JA2 results (solid diamonds) are connected by a smooth curve.

The JAX data in Figures 3a and 3c tend to lie on or above the JA2 line. Also, the JAX data tend to be ranked at a given temperature, the larger values corresponding to specimens with more RDX filler.

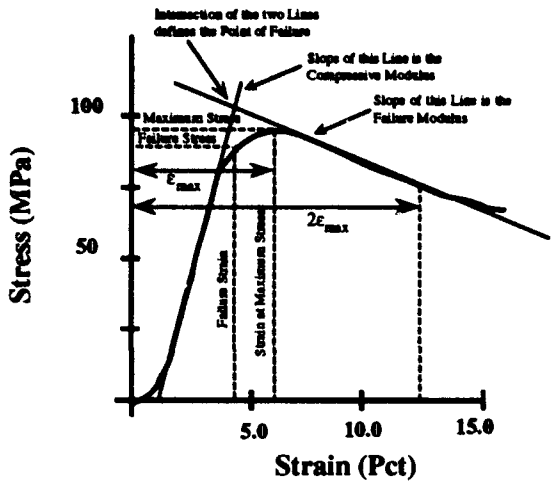


Figure 1. Mechanical Parameters Illustrated

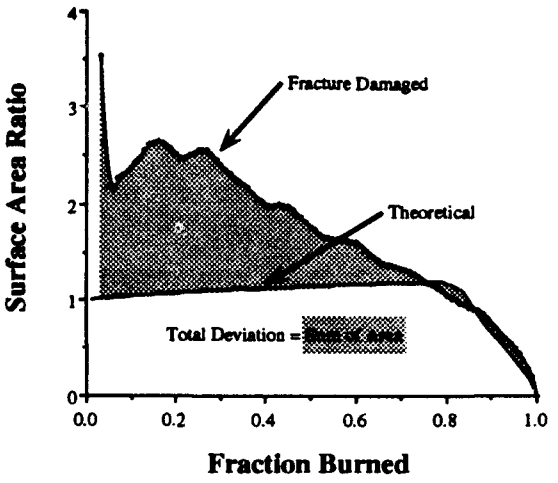
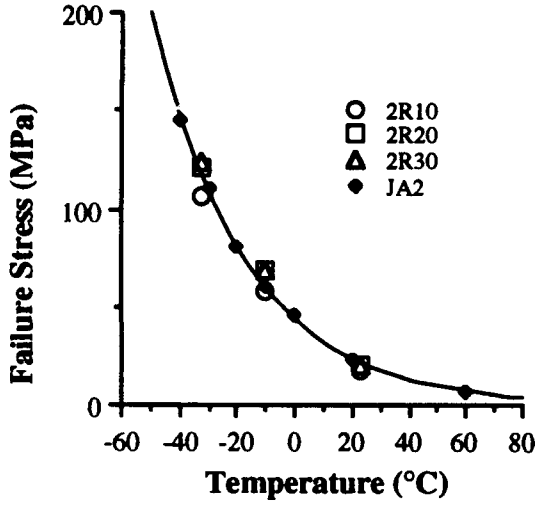
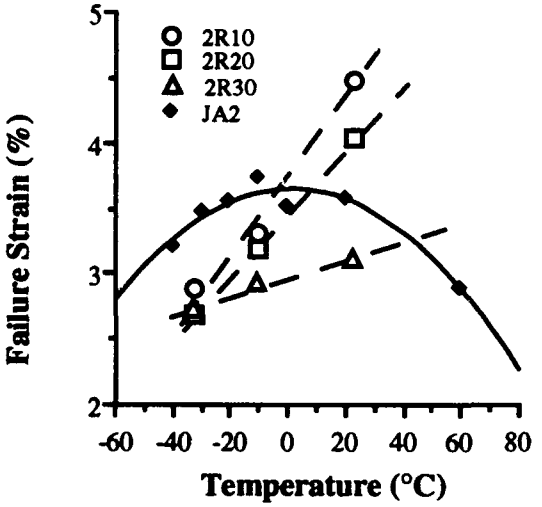


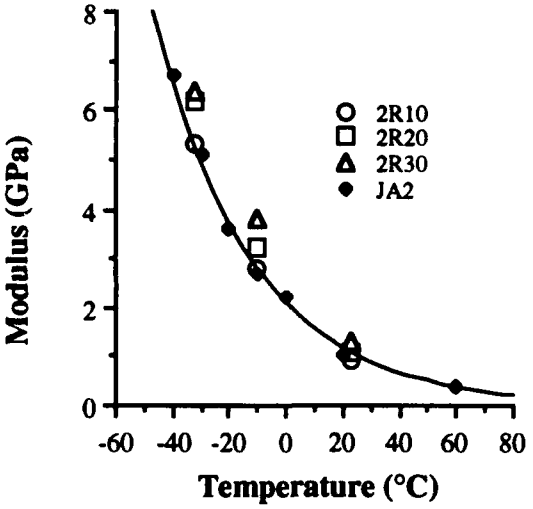
Figure 2. The Total Deviation Parameter



a. Failure Stress vs Temperature



b. Failure Strain vs Temperature



c. Modulus vs Temperature

Figure 3. Mechanical Response Results

The JA2 failure strain curve of Figure 3b decreases in both directions from 0° C. In the lower-temperature direction, the increased brittleness causes failure at lower strain; in the higher-temperature direction, the rapidly increasing softness causes plastic failure, also at lower strain. (Results from dynamic mechanical analysis[11] indicate that glass transition occurs at or slightly below -20° C. See Figure 4.)

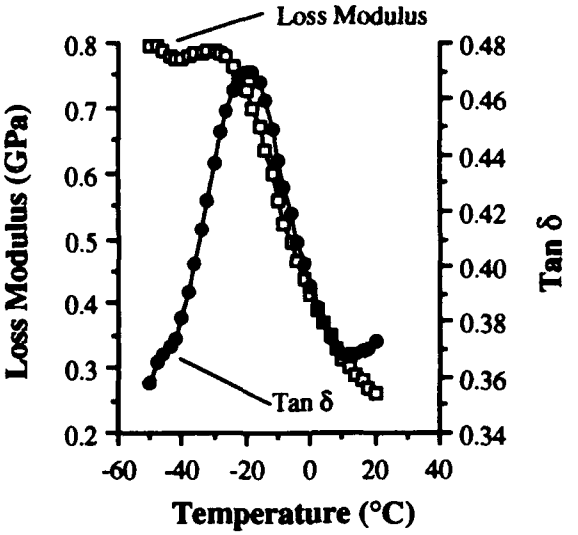
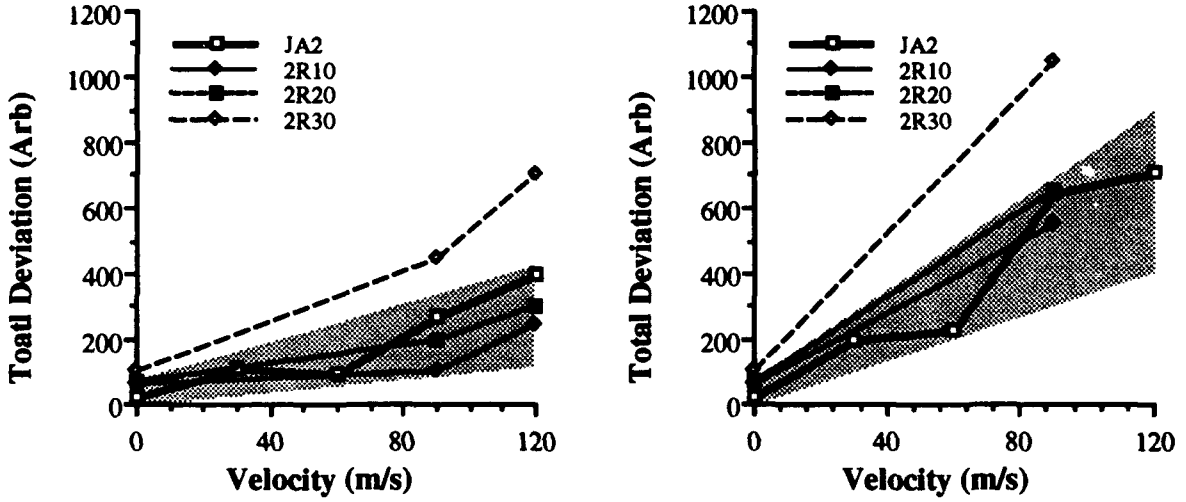


Figure 4. DMA Data for JA2 Which Indicate Glass Transition Temperature Region

Figure 3b shows that the JAX propellants do not soften as JA2 but maintain a brittle character over the temperature range tested. 2R10 and 2R20 exhibit similar slopes, while 2R30 has a much shallower one. Again, the magnitude of the strain at failure tends to be ranked with the level of RDX filler used in the JAX. Looked at another way, the addition of the RDX filler reduces (or possibly eliminates) the gross thermoplastic-flow characteristics of the JA2 propellant at higher temperatures and extends the brittle characteristics of the JAX into the higher temperature regimes.

The GGIT procedure was carried out at three velocity-temperature matrix points for the three JAX formulations. For JAX propellant at -20° C, grain fracture was observed to begin at about 110 m/s, so velocities of 90 and 120 m/s were chosen as two of the matrix points. At -30° C, the third matrix point was selected. The results of these tests and ones previously completed for JA2 are shown in Figure 5. The total deviation (defined earlier, see Figure 2) is an arbitrary scale that measures the



a. -20° C

b. -30° C

Figure 5. Total Deviation vs Impact Velocity for Gas Gun Impact Test

degree that the damaged grain surface-area profile deviates from the profile predicted for undamaged grains. Closed bomb results for undamaged grains, when subject to this analysis, produce total deviations that average about 45 with a range between 30 and about 100. Significant grain fracture is thought to have occurred when values near 200 result. The comparison of fracture damage and fracture susceptibility via the total deviation is made by noting differences in this parameter at similar impact conditions.

Figure 5 shows several things that are evident:

1) As the RDX content of the JAX increases, the fracture susceptibility increases.

2) The fracture susceptibilities of the 10% and 20% RDX compositions of JAX are similar to each other and comparable to JA2. (The shaded area indicates the range of JA2-like behavior.)

3) The 30% RDX composition has a significantly greater fracture susceptibility than JA2 at both -20 and -30° C.

4) These results are self-consistent and consistent with DWMPT results.

2.2 JAX Fracture Response Conclusions.

The mechanical properties and fracture response of JAX were measured under conditions that were thought to show the greatest differences between JA2 and JAX. Measurements showed that at RDX levels near or below 20%, JAX mechanical response was not significantly different from JA2, and may, in fact, have been slightly better (see Figure 5a). At RDX levels near 30%, the DWMPT mechanical response indicated the increase in brittleness would result in the creation of significant fracture-generated surface. This observation was confirmed in GGIT fracture susceptibility tests. JAX with 30% RDX had significantly greater fracture-induced surface area than did JA2, 2R10, or 2R20 under similar impact conditions.

These tests indicate that JAX propellant up to an RDX content of about 20% should not suffer worse fracture-related performance loss or vulnerability susceptibility than JA2, as long as the stress environments are equivalent. At RDX levels of 30% and greater, JAX can be expected to have significantly worse fracture-related performance and vulnerability responses than does JA2 under the conditions in these experiments. This does not say that a JAX propellant cannot be designed to give satisfactory performance under normal interior ballistic conditions. However, when conditions deviate from normal (such as localized ignition at low temperature, or shaped-charge jet interaction) and grain fracture occurs, a JAX propellant can be expected to have a more severe fracture response than JA2. Since JA2 has been shown to be a thermoplastic elastomer with time-temperature equivalence,[12] failure strain results indicate that as the strain rate of the deformation increases, the divergence in mechanical response between JA2 and JAX should increase. That is, as the interaction rates increase, JAX should show an increasingly greater level of brittle response when compared to JA2 (see Figure 3b).

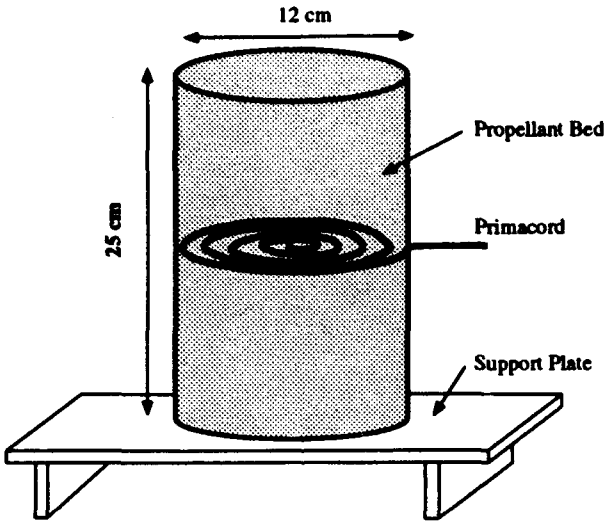


Figure 6. PrimaCord Shock Initiation Test Setup

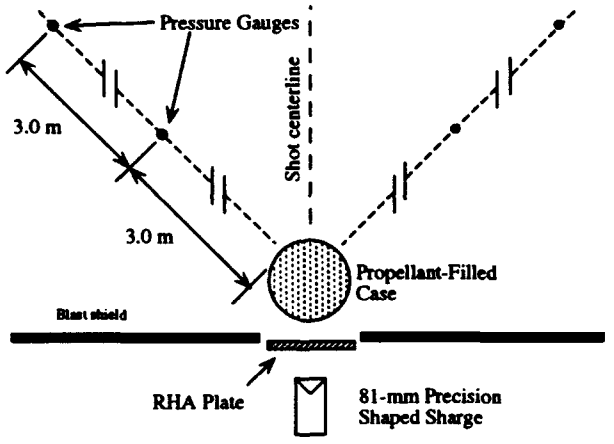


Figure 7. Schematic Diagram of the Air Blast Experiment

3. VULNERABILITY TESTS: DESCRIPTION AND RESULTS

Several vulnerability tests had been performed using these early JAXs as the test propellant. In this section, these tests and their results are outlined in rough chronological order: 1) the Primacord shock initiation test, 2) the air blast test, 3) the shock velocity test, 4) the impulse pendulum test, and 5) the staged compartment test.

3.1 The Primacord Shock Initiation Test.

This test has been designed to rank new propellant formulations by their relative response to explosive shock initiation. It is a simple "go" or "no-go" screening test designed to eliminate those propellants with a demonstrably poor vulnerability response.

Figure 6 shows a schematic of the Primacord shock initiation test setup. A 250-mm section of a 120-mm combustible case is filled halfway with granular propellant. A predetermined length of Primacord, with a mass of about typically 32 g, is coiled and placed on top of the propellant bed. A short length of cord extends through the wall of the case to accommodate the igniter. The case is filled to the top with propellant that is held in place by sealing the case with gun tape. The case is placed on a 305-mm by 610-mm section of 10-mm rolled homogeneous armor (RHA) plate supported by two plates of 51-mm RHA which, in turn, rest upon a large 51-mm section of RHA (not shown). The Primacord is ignited and the propellant reacts. If the 10-mm support plate is destroyed, a detonative event is indicated and usually indentations can be found in the base plate.[2]

These tests indicated a violent response for 2R30 and mild responses for 2R10 and 2R20.[2] These results are consistent with the findings of the fracture response tests of JAX discussed in Section 2. The JAX formulation 2R30 was eliminated from further consideration.

3.2 The Air Blast Test.

A schematic of the test configuration for the air blast measurements is found in Figure 7. An 81-mm BRL precision shaped charge jet is conditioned by a 25-mm RHA plate at a distance of 2 cone

diameters (CD). (This standoff distance has been selected because the jet is thought to have well-defined characteristics [for example diameter, velocity, and length] at this distance.) The conditioned jet proceeds through and interacts with the propellant. The shock wave produced by the jet-propellant interaction is detected by in-ground pressure gages that are located along radii 45° on either side of the jet center line. The pressure gages are situated in lead shields sunk into ground. The entire test area had been graded and leveled. The data consists of time of arrival of the shock and the pressure measured at a given location. For comments on the difficulty of obtaining reliable data from this type of test, see Reference 13.

Table 2 shows data for an inert material, JA2 in both granular and PcS geometries, and a number of JAXs. The upper section of this table refers to the data taken at the 3.0-m locations while the lower section refer to those data taken at the 6.1-m locations. The left most column identifies the Range 10 shot number; the second and third columns identify the propellant used; the fourth and fifth columns tell the geometry (granular or partially cut stick) and the perforation (7 or 19). The sixth column shows the weight of each propellant in kilograms. The next columns display the results. Pressure values measured along the left (L) and right (R) legs, as well as the average (A) of both legs are show in columns 7, 8 and 9, respectively, in Table 2. The right most column shows the average arrival time of the shock.

Figures 8 and 9 graphically display the average air blast results for the different propellants. The JA2 responses are slightly greater than the inert material response. On the other hand, the JAXs give a more violent response.

Figures 10 and 11 show the air blast arrival times. The inert material exhibits the longest times (i.e., slowest shock wave, which in this case must be due only to the shaped charge jet itself). The arrival time for the JA2 propellants is slightly faster. The JAXs, however, all show significantly

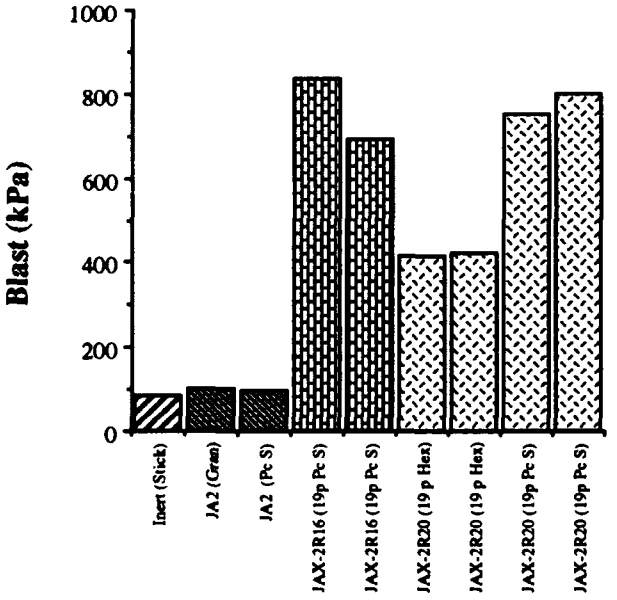


Figure 8. Air Blast Pressure at 3.0 m

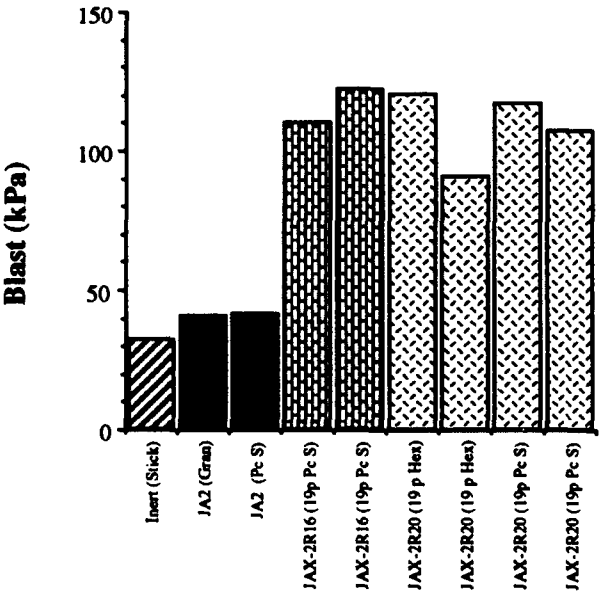


Figure 9. Air Blast Pressure at 6.1 m

Table 2. 3.0 and 6.1-m Air Blast Data

Shot Number	Lot Number	Propellant Name (geometry)	Number Perfs	Mass (kg)	3.0-m Blast Line (kPa)			3.0-m Arrival Time (msec)
					Left	Right	Average	
S-NG711901	Orange EC	Inert (Stick)	7	3.5	82.7	No Data	82.7	5.4
S-NG711903	RAD00M0015102	JA2 (Gran)	7	4.1	124.0	87.5	99.2	4.7
S-NG716702	RAD792-32	JA2 (Pc S)	19	4.8	96.5	99.2	97.8	4.8
S-NG716203	HCL87A010-002	JAX-2R16 (19p Pc S)	19	4.9	654.6	1005.9	834	1.9
S-NG716703	HCL87A010-002	JAX-2R16 (19p Pc S)	19	5.3	792.4	592.5	692	1.9
S-NG711902	HCL86H003-009	JAX-2R20 (19 p Hex)	19	3.9	441.0	385.8	413	2.1
S-NG716901	HCL86H003-009	JAX-2R20 (19 p Hex)	19	3.9	430.6	413.4	422	2.2
S-NG716903	HCL86H003-009	JAX-2R20 (19p Pc S)	19	4.8	778.6	723.5	751	1.9
S-NG716302	HCL86H003-009	JAX-2R20 (19p Pc S)	19	5.0	792.4	806.1	799	1.8

Shot Number	Lot Number	Propellant Name (geometry)	Number Perfs	Mass (kg)	6.1-m Blast Line (kPa)			6.1-m Arrival Time (msec)
					Left	Right	Average	
S-NG711901	Orange EC	Inert (Stick)	7	3.5	33.1	32.4	32.7	12.9
S-NG711903	RAD00M0015102	JA2 (Gran)	7	4.1	41.3	40.0	40.7	12.0
S-NG716702	RAD792-32	JA2 (Pc S)	19	4.8	48.2	34.5	41.3	11.0
S-NG716203	HCL87A010-002	JAX-2R16 (19p Pc S)	19	4.9	117.1	103.4	110.2	7.1
S-NG716703	HCL87A010-002	JAX-2R16 (19p Pc S)	19	5.3	158.5	86.1	122.3	6.9
S-NG711902	HCL86H003-009	JAX-2R20 (19 p Hex)	19	3.9	124.0	117.1	120.6	7.5
S-NG716901	HCL86H003-009	JAX-2R20 (19 p Hex)	19	3.9	89.6	92.3	90.9	7.7
S-NG716903	HCL86H003-009	JAX-2R20 (19p Pc S)	19	4.8	130.9	103.4	117.1	6.7
S-NG716302	HCL86H003-009	JAX-2R20 (19p Pc S)	19	5.0	103.4	111.6	107.5	6.7

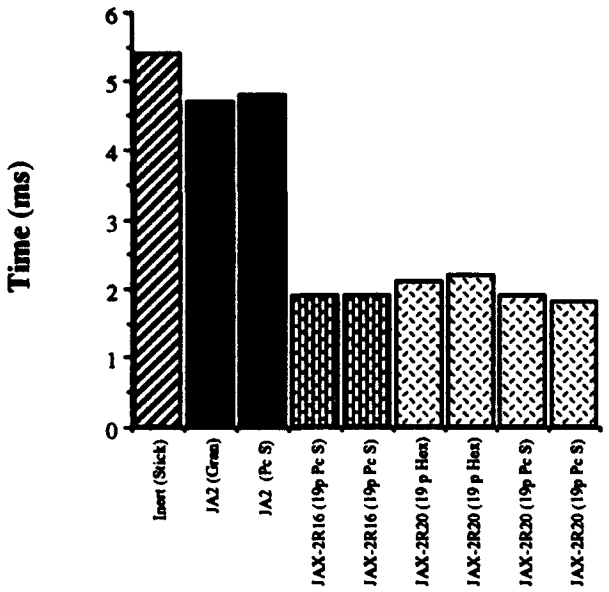


Figure 10. Air Blast Arrival Time at 3.0 m

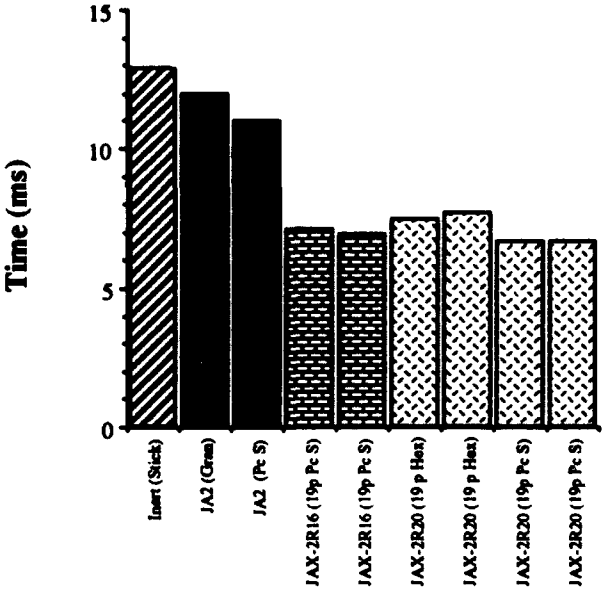


Figure 11. Air Blast Arrival Time at 6.1 m

faster arrival times, again indicative of a more violent reaction.

3.3 The Shock Velocity Test.

Figure 12 shows a schematic of the shock velocity test.[14, 15] An 81-mm BRL precision shaped charge is aimed at the center of the box of propellant. The shaped charge is fired, the jet is formed, and is conditioned by 51 mm of RHA. It then strikes the trigger plate and interacts with the propellant within the wooden box. Any residual jet is captured by the stack of RHA blocks. At a position 80 mm from the upper surface of the catcher blocks, the upper surface of the third RHA block was indexed to obtain a measure of the actual center-line of the jet. The 2R16 19-perforation stick JAX was broken at the kerfs to provide "grains" with an L/D about unity.

The wooden propellant box is made 250-mm square and 80-mm deep. In the vertical center plane of this box (i.e., 40 mm below the trigger),

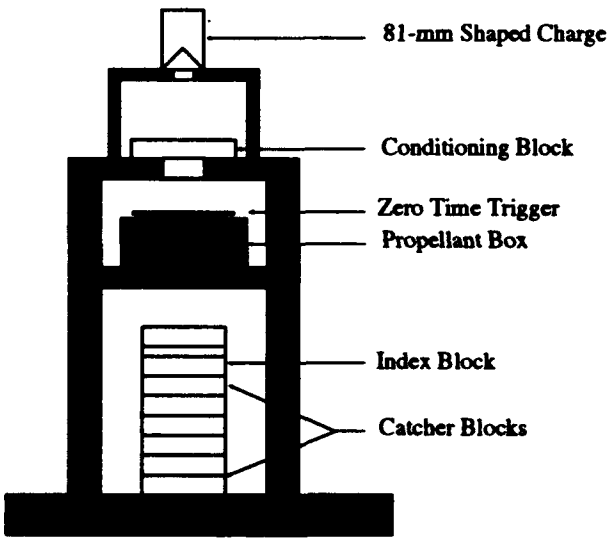


Figure 12. Schematic of the Shock Velocity Experiment

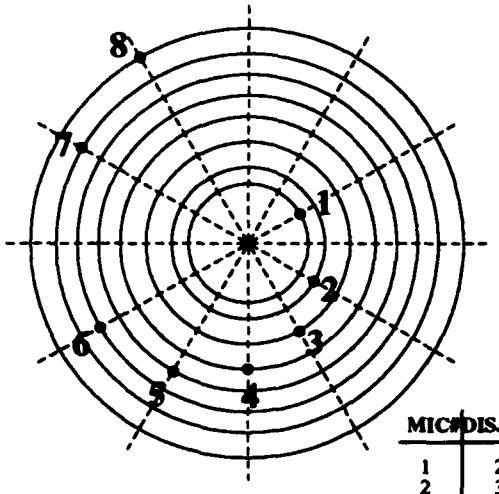
Table 3. Shock Velocity Coefficients

Shot Number	Propellant Name	Lot Number	A	B	C
16	INERT	WEP	-10.50	0.35	25.70
17	INERT	WEP	-6.19	0.21	16.40
36	2R16	HCL-87A-010-002	7.39	0.08	-10.60
41	JA2-19p	RADPE-792-11	-6.41	0.22	17.30
43	JA2-19p	RADPE-792-11	-7.61	0.26	19.60
44	JA2-19p	RADPE-792-11	-6.97	0.24	18.50

eight sacrificial microphones are positioned at progressively increasing radii from the center (see Figure 13). The microphones are located on radii 28 mm to 102 mm from the center of the box. The shock front from the propellant-jet interaction passes through the propellant bed and is sequentially detected by the microphones. Since the location of each microphone is known, the basic data consists of time of arrival of the shock front vs location. Differentiation provides velocity vs time information.

Table 3 identifies the lot numbers for several propellants, their shot numbers, and their coefficients in the empirical formula:

$$\text{shock velocity (km/s)} = A + Bd^{+0.5} + Cd^{-0.25}. \quad (1)$$



MIC#	DIS. (mm)	(°)
1	28	30
2	36	330
3	48	300
4	60	270
5	70	240
6	80	210
7	90	150
8	102	120

Figure 13. Schematic of Microphone Locations

Equation (1) has been used to compute the information in Table 4 for shots 16, 17, 36, 41, 43, and 44. The average of shots 16 and 17 (the inert shots) and the average of 41, 43, and 44 (the JA2 shots) are also shown in Table 4. The sigma column is the standard deviation of the three JA2 shots.

Figure 14 shows the shock velocity of the average inert, the average JA2 and the 2R16 plotted against distance from the center of the box. The inert material and JA2 propellant show a shock with monotonically decreasing velocity. By contrast, the 2R16 JAX exhibits an accelerating velocity with distance. These results clearly indicate that the response of the JAX is more violent and of a different nature than the response of the JA2.

Table 4. Shock Velocities (km/s) as a Function of Distance

Distance (mm)	Shots								
	16	17	Average 16, 17	36	41	43	44	Average 41, 43, 44	Sigma
20	3.21	2.50	2.85	2.75	2.75	2.82	2.85	2.81	0.05
30	2.40	1.96	2.18	3.30	2.18	2.18	2.24	2.20	0.04
40	1.93	1.66	1.79	3.69	1.86	1.82	1.89	1.86	0.04
50	1.63	1.46	1.54	3.97	1.64	1.60	1.67	1.64	0.04
60	1.44	1.33	1.38	4.21	1.50	1.44	1.54	1.49	0.05
70	1.31	1.23	1.27	4.40	1.41	1.33	1.42	1.39	0.05
80	1.22	1.17	1.19	4.56	1.34	1.26	1.36	1.32	0.05
90	1.16	1.12	1.14	4.71	1.28	1.22	1.32	1.27	0.05
100	1.12	1.10	1.11	4.84	1.26	1.18	1.28	1.24	0.05

3.4 The Impulse Pendulum Test.

Figure 15 shows a schematic of the impulse pendulum test apparatus.[16] In this test, propellants are placed in a cardboard shipping container, nominally 150 mm in diameter and 520 mm long. The attack path is diagonally through the center of mass of the propellant and placed at a convenient angle (but constant) so that the jet will miss the pendulum bob. The attack is by unconditioned bare Viper placed 2 cone diameters away from the propellant charge. The shock wave, produced by the interaction of the Viper's jet and the candidate propellant, impinges upon the nearby pendulum bob of massive weight. The distance between the propellant tube and the pendulum face is 305 mm. The displacement and the period of the pendulum are measured directly and the total impulse delivered to the pendulum is calculated from the following formula:

$$\text{Impulse} = 2\pi\,[\text{Mass} \times \text{Displacement/Period}]. \qquad (2)$$

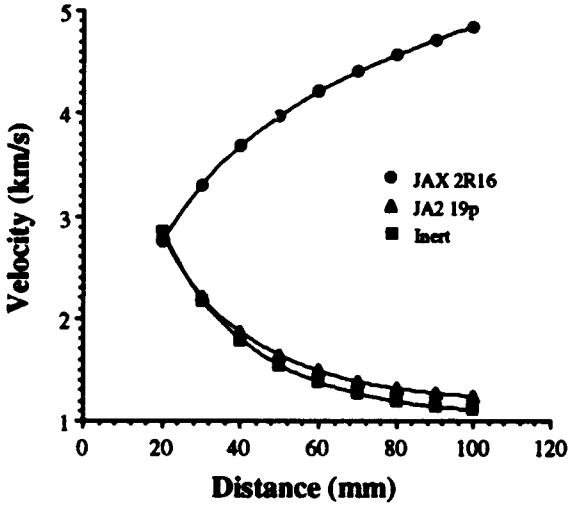


Figure 14. Shock Velocity Data for JA2 and JAX

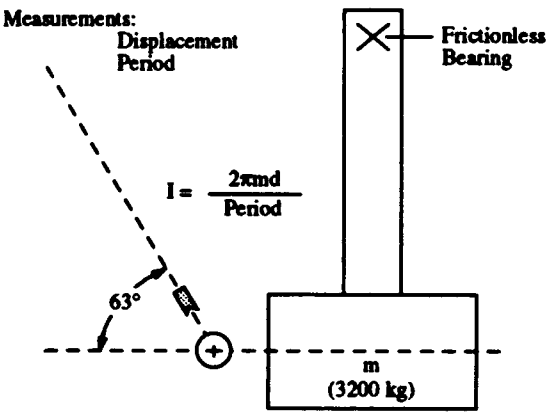


Figure 15. Schematic of the Impulse Pendulum Test

The contribution of the shaped charge itself is determined by shooting into a cardboard container filled with sand. This contribution is small and subtracted from the calculated impulse to obtain the impulse due to the jet-propellant interaction alone. Results are ranked in a relative fashion.

Table 5 identifies the propellant, the shot number, and the net impulse in N-s. The table is divided according to whether the weight of propellant tested was 2.3 kg or greater than 2.3 kg. Figure 16 shows the results for the 2.3-kg tests. Again, it is evident that 2R20, either in the granular or stick geometry, exhibits a greater response than the JA2. The results in Figure 17 are even more dramatic. Here JA2 at the 7.3-kg and 10-kg levels has about five times lower response than the 2R20 at the 7.3-kg level. This is further evidence that the JAX responds in fundamentally different fashion relative to JA2.

Table 5. Impulse Pendulum Data

opellant Name (type)	Mass (kg)	Lot Number	Shot Number	Impulse (N-s)
JA2 (7p)	2.3	RAD-84G-001-S176	88-10	612
JA2 (19p)	2.3	RAD-PE-792-11	88-11	657
JA2 (19 PcS)	2.3	RAD-PE-792-33	88-30	843
JAX 2R20 (7p PcS)	2.3	HCL-86C-006-004	88-27	1484
JAX 2R20 (19 p Hex)	2.3	HCL-86H-003-009	88-13	1618
JAX 2R20 (19p PcS)	2.3	HCL-86C-004-001	88-14	1896
JA2 (7p)	4.5	RAD-84G-001-S176	88-25	872
JA2 (19 PcS)	10.	RAD-PE-792-33	88-28	1201
JA2 (19p)	7.3	RAD-PE-753-10	88-26	1208
JAX 2R20 (7p PcS)	7.3	HCL-86C-006-004	88-29	5614

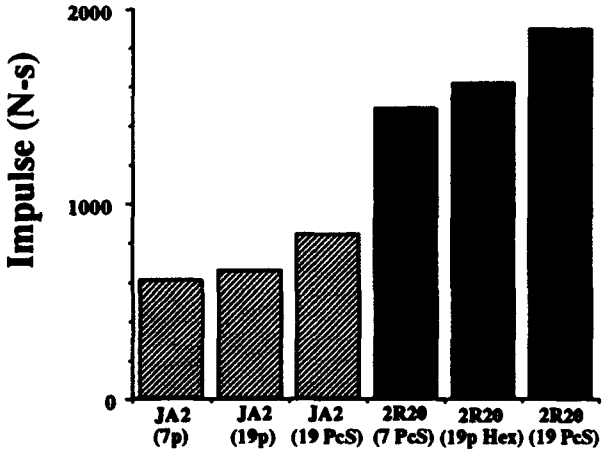


Figure 16. Impulse Pendulum Data for 2.3-kg Quantities of JA2 and JAX

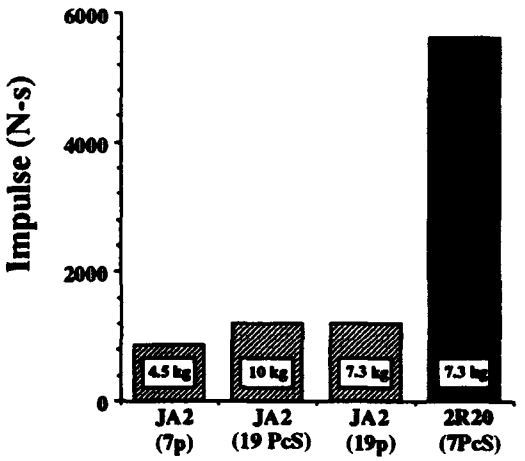


Figure 17. Impulse Pendulum Data for Various Amounts of JA2 and JAX

3.5 The Staged Compartment Test.

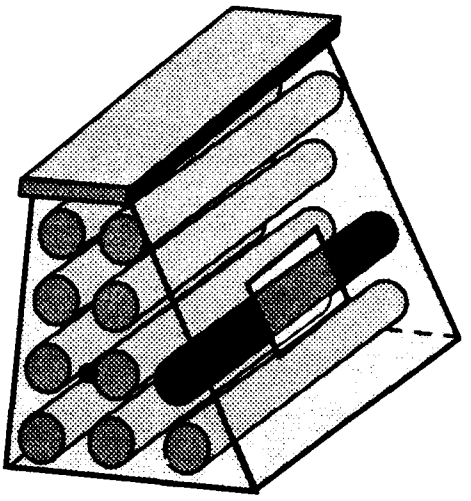


Figure 18. Schematic of the Ten-Round Staged Compartment Test (The target round is darkened.)

These tests characterize the relative response of candidate propellants in confined quarters that simulate the volume of the stowage compartment of an M1 tank. The apparatus used in this test is shown in Figure 18 and is capable of holding ten rounds of sleeved 105-mm ammunition. However, in these experiments, 2.3 kg of propellant are placed in a cardboard tube and blocked with wood. This tube is then located within a standard aluminum stowage sleeve that is placed in the test apparatus on the second tier from the bottom, in front of the hole cut into the angled face of the armor. Only the sleeved 2.3-kg propellant charge is in the compartment. The threat is an 81-mm BRL precision shaped charge located at standoff of 2 CDs (not shown). The jet passes through 25 mm of RHA that is backed by 13 mm of Isodamp. The conditioning armor pack (not shown) is located against the slant wall of the compartment and the jet is aimed at the center of mass of the propellant. Two mounts for Kistler gages (calibrated to 13-MPa peak pressure) are located in both end walls of the compartment, in a plane parallel to the direction of the shaped charge jet attack. These gages provide (duplicate) pressure vs time data. The pressure-time curve is integrated (up to 10 ms) to provide specific impulse vs time information.

Table 6 identifies the propellants tested in the staged compartment apparatus. The testing of JA2 propellant took place on February 11, 1988, while the testing of 2R20 propellant took place on April 12, 1988. Figure 19 shows the computed impulse plotted against time for the four propellants listed in Table 6. It is obvious that the JA2 response is about five times lower than the JAX response.

3.6 Summary of JAX Vulnerability Testing.

The mechanical properties tests, even at low temperatures, did not show an obvious correlation with the vulnerability tests that involved shaped charge jets interacting with the JAX propellant bed. This is not surprising since the role that mechanical properties play has been shown to be secondary to that of chemistry.[17]

All five tests discussed previously show that the response of JAX is fundamentally different from the response of JA2. Since JAX is manufactured by adding 30% RDX (or less) to JA2, the question arises: What is the specific mechanism that causes JA2 to go from a low response propellant, one that generally mimics the inert material response, to the violent response observed for the JAXs? The remainder of this report discusses how we began to address this question and what was found.

Table 6. Staged Compartment Propellants

Propellant	Lot#
2R20	HCL-88C-006-004
JA2 19P STICK	RAD-PE-792-33
JA2 19P GRAN	RAD-PE-792-11
JA2 7P GRAN	RAD-PE-001-S176

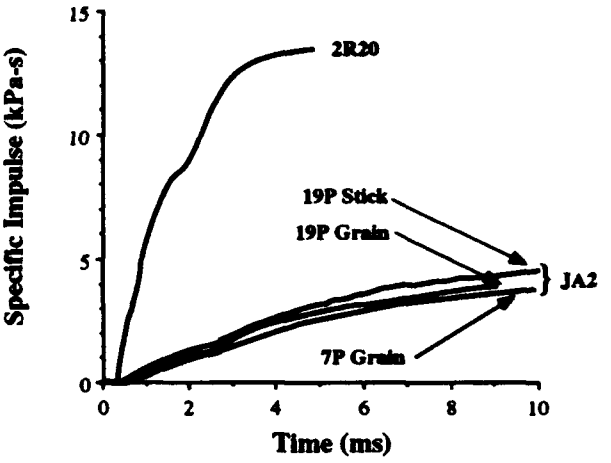


Figure 19. Staged Compartment Test Results for 2.3-kg Quantities of JAX and JA2

4. JAX MORPHOLOGY

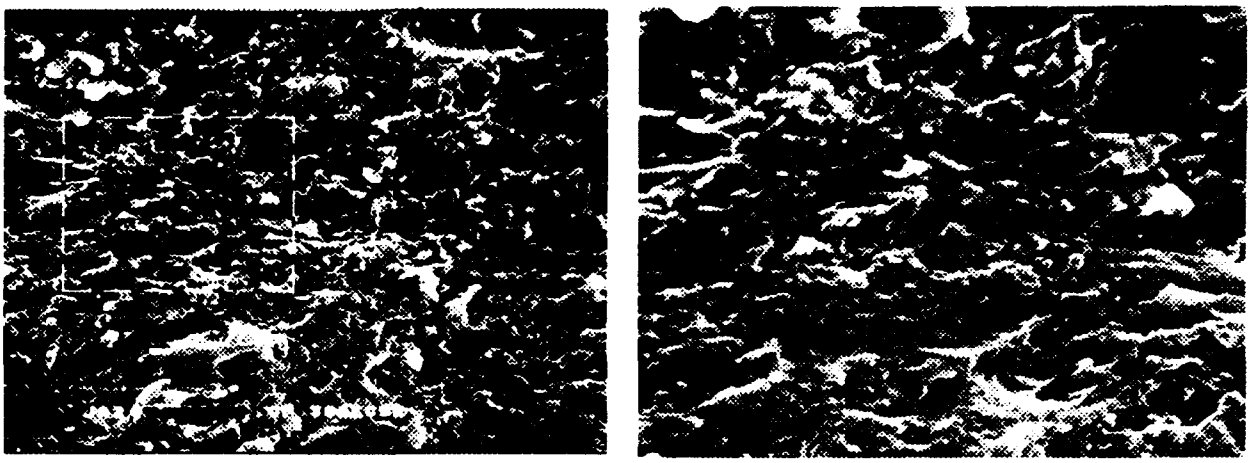
4.1 SEM Background.

The physical arrangement of the processed material is very important to propellant performance. Defects such as voids, cracks, agglomerates, or foreign material can have a deleterious effect on the programmed burning of the charge by changing the mass generation rate of the propellant. This is done by supplying augmented surface area directly or through the resulting fracture, or by simply changing the intrinsic burning rate of the propellant. For this reason, scanning electron microscopy (SEM) has been adopted as a standard method of detecting these defects. Each propellant lot undergoing investigation is examined by SEM to ensure that the structure has its intended integrity. SEM micrographs are also used to assure that there are no processing problems, such as poor mixing of materials. Information may be uncovered during a routine SEM morphological screening examination that would alert researchers to potential performance problems and could eliminate or redirect subsequent testing.[5]

Therefore, undamaged specimens of each type of JAX propellant were cold fractured at dry ice temperatures. The low-temperature fracture reduces the possibility of introducing artifacts into the structure. Since cracks propagate through the material by a path of least resistance and defects usually supply a lower resistance pathway, the likelihood that a crack will encounter a defect (if it exists) as it propagates is enhanced. This process results in more defects being exposed at the fracture surface than would be represented in random sectioning of the specimen. Conversely, if no defects are seen on the newly exposed surface, it is likely that the defect population is small.

4.2 SEM's of JA2 Grains.

Figure 20 shows micrographs of the cold-fractured surface of typical JA2 propellant and is presented as a basis for comparison. JA2 is a thermoplastic elastomer that undergoes a transition from mostly plastic to brittle behavior at about -20° C at deformation rates on the order of 100 s^{-1} (see Figure 4). The typical JA2 cold-fracture surface is smooth, indicating brittle fracture. Some nitrocellulose (NC) is observed because the high nitration level (13.1%) of the NC prevents all of the fiber from dissolving in the plasticizer. Other propellants that use lower levels of nitration (12.6%)



10 μm

10 μm

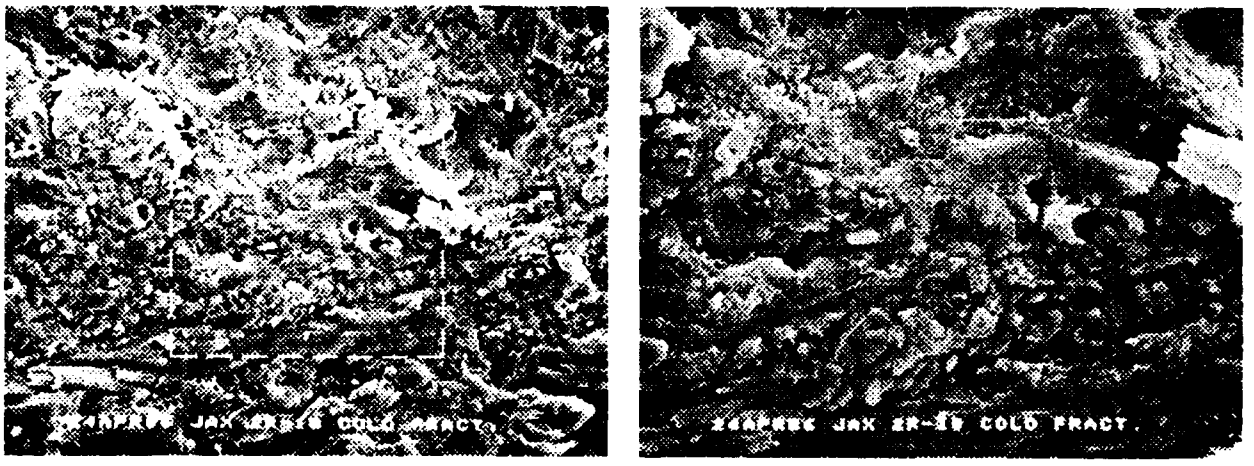
a. ≈700X b. ≈2000X

Figure 20. Micrographs of the Cold-Fractured Surface of JA2 Propellant

have the NC completely dissolved and do not show exposed fibers. The only other notable feature in typical JA2 propellant is the presence of very small (0.5 - 2 μm) particles distributed throughout the propellant. Their identity has not been established. They could be very fine carbon black, which is an added ingredient, or they could be small particles of MgO that are added during mixing to aid in the extrusion process. In any case, they seem to be found throughout the material.

4.3 SEM's of JAX Grains.

Figure 21 shows micrographs of 2R10, a JAX propellant. RDX particles that are less than 5 μm in diameter are observed in these micrographs. The surface is not as smooth as the JA2 surface in Figure 20, but other JA2-like features are present, such as NC fibers and very small particles. The



20 μm

10 μm

a. ≈400X b. ≈800X

Figure 21. Micrographs of the Cold-Fractured Surface of 2R-10 JAX Propellant

10 μm (≈800X)

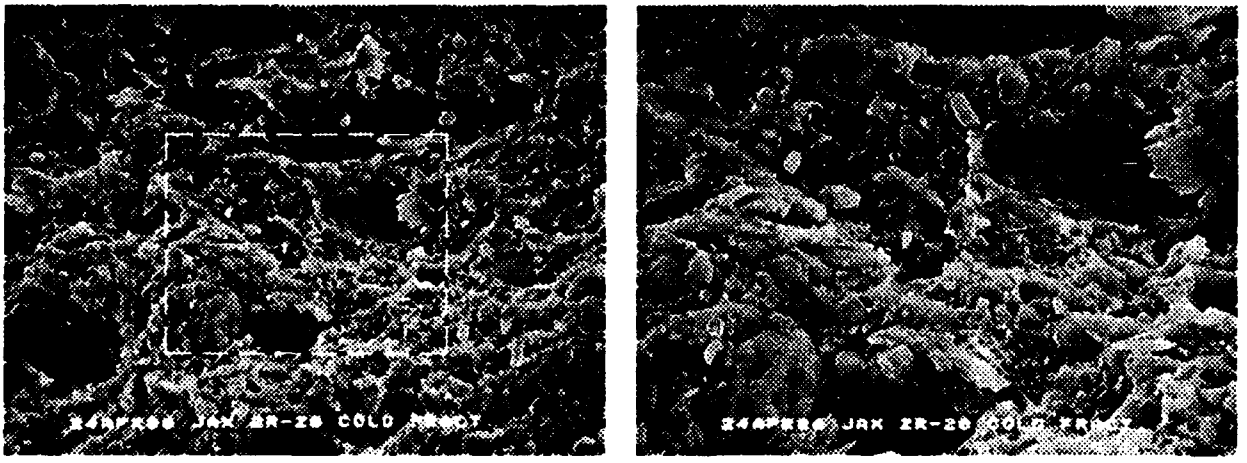
Figure 22. Nitramine Base Propellant with RDX in the 2 - 20 μm Particle Size Range

only unusual feature is that the particle size of the RDX is considerably smaller than expected. The distribution of particle sizes that was added to make JAX, and that typically appears in nitramine base propellants, has most of the particles within a range of 2 to 20 μm. Figure 22 shows an example of a nitramine base propellant. It has 76% RDX filler that falls within the 2-20 μm range. This range is representative of the RDX particles size distribution expected in the JAX specimen but was not observed.

Micrographs of JAX propellant with 20% RDX filler are found in Figure 23. As expected the number density of particles is greater, but the particle size is still about 5 μm. The fracture surface is rougher than the 2R10 surface (see Figure 21). This was caused by the greater number of particles (i.e., defect locations) diffusing the path of the crack during the specimen preparation.

Micrographs of the 30% filled JAX propellant are presented in Figure 24. There are similar changes due to the increased concentration of RDX as were noted in Figure 23. There are more particles present and an even rougher surface. The major difference noted here is that the RDX size distribution seems to be more in line with what was expected.

The observations made for these three lots of JAX propellant are significant and consistent when considered in light of information that was gathered when a more recent production of JAX propellant was made. The JAX micrographs presented in Figures 22, 23, and 24 were taken when the propellant was first delivered in the Spring of 1986. A more recent production was manufactured



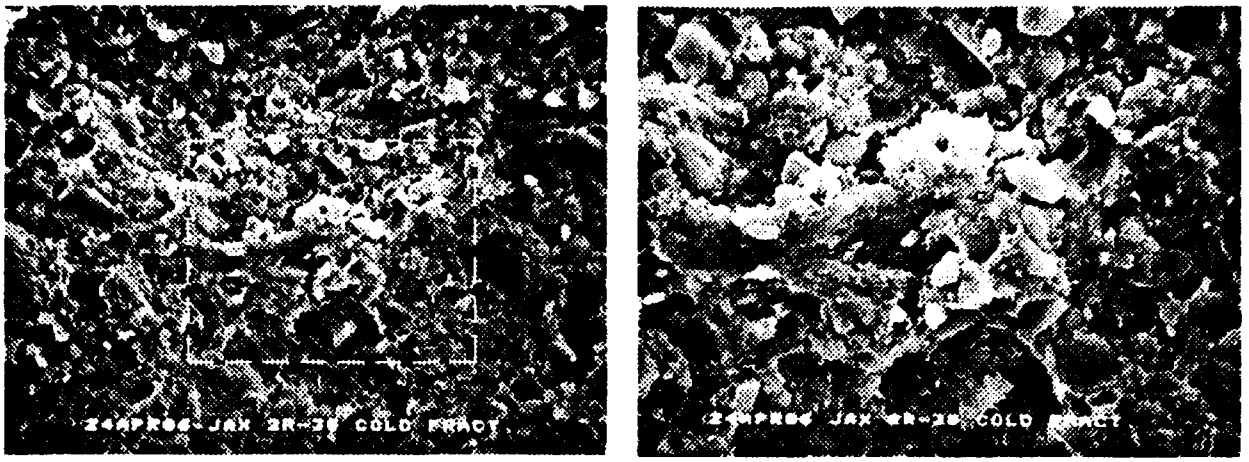
20 μm

a. ≈400X

10 μm

b. ≈800X

Figure 23. Micrographs of the Cold-Fractured Surface of 2R-20 JAX Propellant

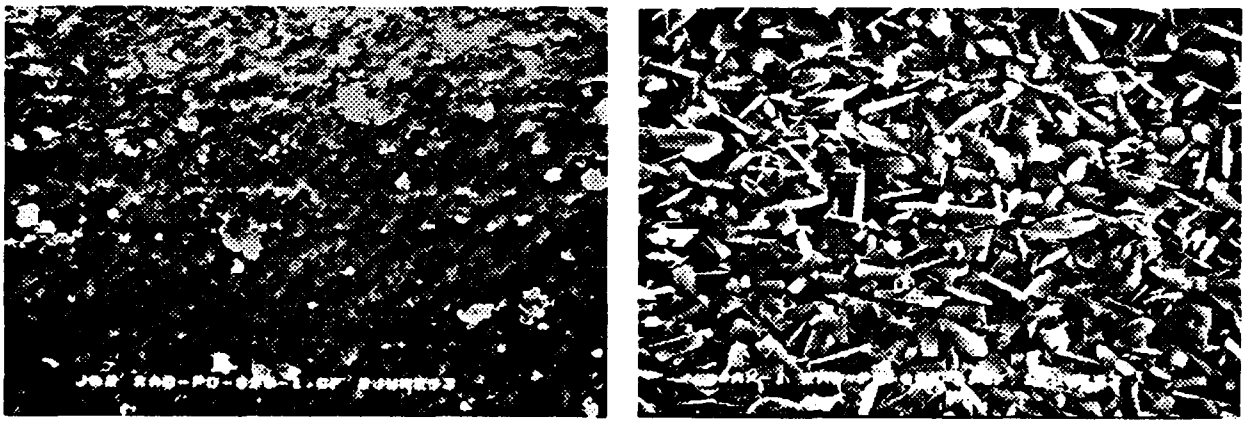


20 μm 10 μm

a. ≈400X b. ≈800X

Figure 24. Micrographs of the Cold-Fractured Surface of 2R-30 JAX Propellant

at the Radford Army Ammunition Plant in February 1993.[3] The objective in making the newer JAX had been to test the effects of using recrystallized RDX rather than fluid-energy-milled RDX in a JAX composition. This lot was received for routine morphological testing and was cold fractured to investigate the structure. Crystals were observed covering the surfaces of the perforation walls. These observations had not been made with any previous lot of JAX. However, the only surfaces that were investigated using the earlier propellant were cold-fracture surfaces. Micrographs of early lots were inspected for similar observations, but there were no portions of micrographs that showed perforation surfaces of sufficient magnification to confirm the presence of crystals growth. Figure 25 shows a comparison between a JA2 perforation surface and the corresponding surface of a 2R7.7 JAX grain. All perforations showed similar crystal structure. All areas of every perforation showed evidence of crystal growth.



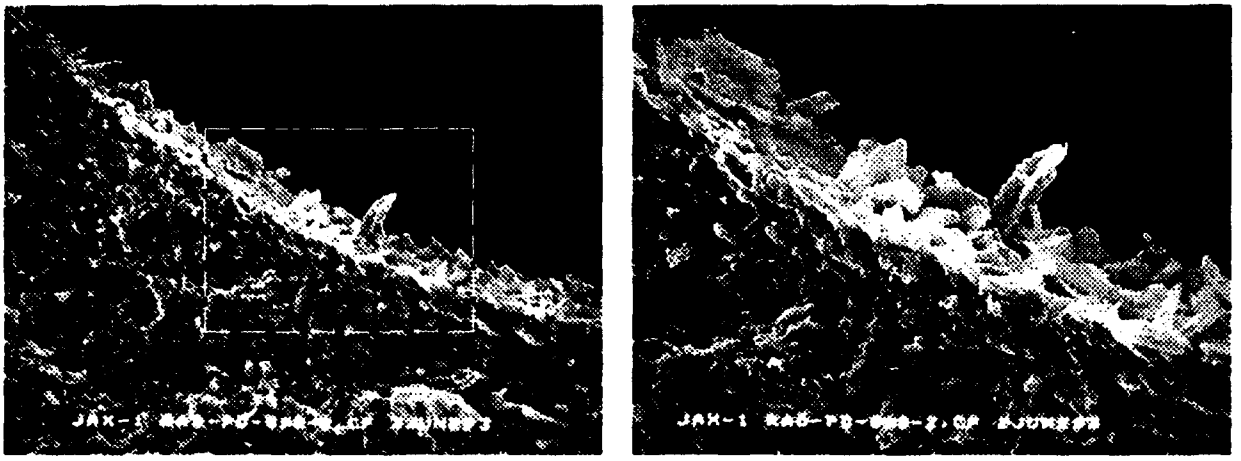
20 μm 20 μm

a. JA2 (≈400X) b. JAX-1 with RDX Crystals (≈400X)

Figure 25. Micrographs of the Inner Perforation Surface of JA2 and JAX-1 Propellants

To understand the physical nature of the deposition process, the specimen used in Figure 25 was cold fractured along the radial direction of the grain. This provided an orthogonal view from the one presented in that figure, and provided an opportunity to observe the extent of the crystal growth.

Figure 26 shows the radial fracture surface. Attention is called to the whiter band of material that sits on the gray bulk of the propellant grain. It is clear that the crystals reside only on the extrusion surface. There is no extension of the crystals below a sharp line of demarcation, the extruded perforation surface.



20 μm

a. ≈400X

10 μm

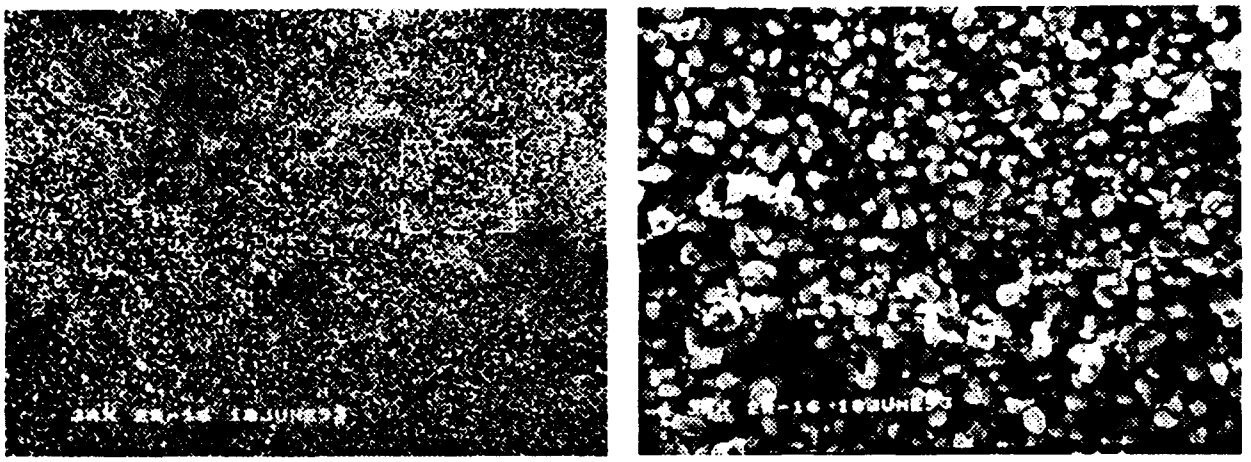
b. ≈800X

Figure 26. Micrographs of the Inner Perforation Surface of JAX-1 Shown in Figure 11b Cold-Fractured in the Radial Direction

The more recent lots of JAX were not the only ones to exhibit this crystallization phenomenon. The JAX propellant that was studied in 1986 (2R10, 2R20, 2R30, and 2R16) was still in storage in the magazine. It had been undisturbed for 7 years and was retrieved to see if this crystal growth could be seen in the perforations. When the ungraphited 2R16 JAX propellant was brought to the laboratory, a white "powder" was visible on its outside surfaces. Specimens of whole grains were prepared for SEM analysis and micrographs of the outside surface of the grain appear in Figure 27. Since the crystals must have appeared after extrusion, and since the crystals seem to appear upon annealing or long-term storage, the deposition mechanism is likely to be precipitation after transportation to the surface by means of solution.

4.4 Crystal Identification.

Positive identification of these crystals was needed and was obtained. The identification strategy consisted of 1) examining the surface of the perforations, where the crystals had been detected; and 2) examining the bulk material, away from external surfaces, as a control. The microreflectance-FTIR spectra of the JAX surfaces (see Figure 25b) were obtained using a Mattson Polaris FTIR spectrometer and a Spectra-Tech IR-Plan infrared microscope with a MCT detector.[18] The software included Kramers-Kronig transformations to correct spectral distortions. For both spectra, 32 scans were collected with a resolution of 8 cm^{-1}. The scans are shown in Figure 28.



100 μm

20 μm

a. ≈80X

b. ≈400X

Figure 27. Micrographs of the Exterior Surface of 2R-16 JAX Propellant after 7-Year Storage

Attention is drawn to the ordinate of Figure 28 in the region between 1500 and 1700 cm^{-1}. From other spectra (not shown), an RDX spectral signature lies at about 1600 cm^{-1} and an NC spectral signature lies at about 1660 cm^{-1}. In the upper scan labeled "Bulk Surface of JAX" (Figure 28), we see the NC spectral signature at 1660 cm^{-1}, but little or no indication of an RDX spectral signature at 1600 cm^{-1}. On the other hand, the lower scan, labeled "Perforation Surface of JAX" (Figure 28), we do find the RDX spectral signature at about 1600 cm^{-1}. The shape of the derived NC spectral signature at about 1660 cm^{-1} is distorted. This results from a failure of the Kramers-Kronig transformation to perfectly compensate for the specular reflection of the crystals on the surface.

The crystals were positively identified as nitramines and we concluded that they were recrystallized RDX. With the information thus far it was hypothesized that some type of migration process was occurring that resulted in the deposition of RDX on the exterior surfaces of JAX propellants.

4.5 The Formation of Crystals on JAX Surfaces.

Processing records indicated that annealing of the propellant was performed for 6 hours at 43° C after extrusion and cutting to relieve residual grain stress . Annealing is routinely performed as a part of JA2 processing, and was included in the JAX processing.[3] Thus, if heating were to accelerate the RDX deposition, all JAX materials should have RDX crystal growths on their external surfaces after manufacture.

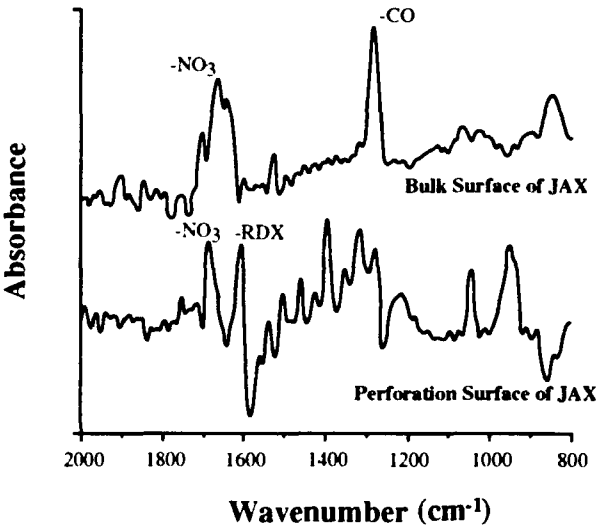


Figure 28. Microreflectance FTIR Spectra of JAX Surfaces

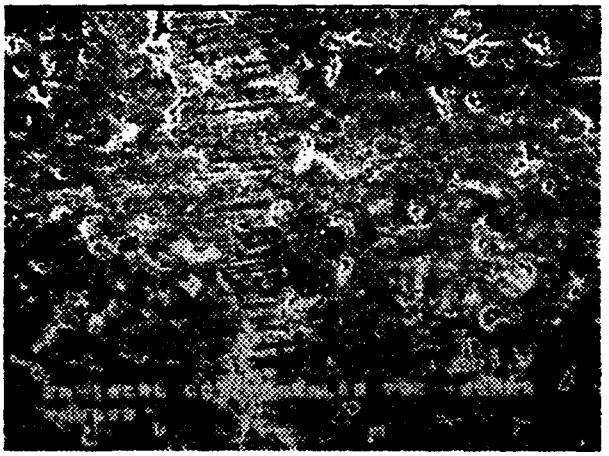
After annealing, the grains are tumbled to apply a graphite coating that aids in loading operations and increases packing density. We infer that the newer grains had the RDX removed from exposed outside surfaces during the tumbling process. This explains why crystals were found only within the perforations for the recently produced JAX. Grains stored for extended periods of time either were exposed to high temperatures (storage history is unknown) or the solution that transports the RDX to the surface had sufficient time to form these crystals after slowly evaporating.

As stated earlier, the annealing step in the processing of JAX suggests that heat might promote the RDX formation. We devised a simple test of this proposal. Specimens of JAX (2R16) were cut at 21° C (not cold-fractured) to expose fresh surface area that contained no crystals. One half of the grain was placed into an oven at 75° C for 65 hours. The other was placed within a laboratory hood at room temperature. After 23 hours the propellant specimens were removed from the annealing oven and inspected; crystals were observed on the surfaces. The control showed no sign of crystal formation. The samples were returned to the oven and the hood and after 65 hours they were again examined using the SEM. There was about the same number density of RDX crystals on the heated samples as there was after 23 hours, but the crystals were larger. The SEM results for heated and control samples after 65 hours are shown in Figure 29.

4.6 The Role of DEGDN.

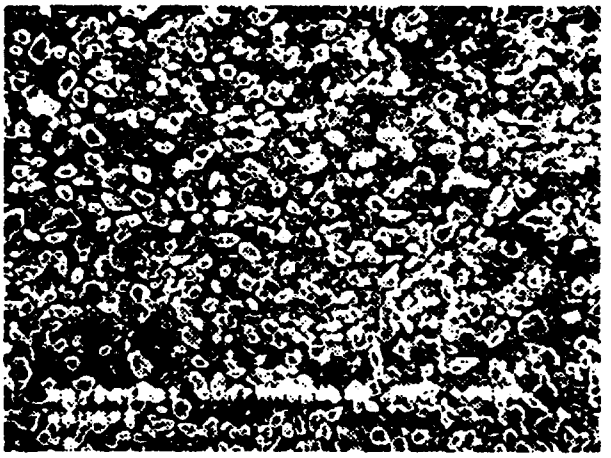
Evidence from thermogravimetric analysis experiments shows large weight losses (13.5 to 19%) for JA2 upon exposure to elevated temperatures. Table 7 shows the weight loss observed for the propellants JA2, M30, and M43 upon exposure to 60° C for 1000 minutes and upon exposure to 100° C for 360 minutes.[19]

The candidates responsible for this relatively large weight loss observed for JA2 are the plasticizers DEGDN or NG. Table 8 shows the vapor pressure for these two neat materials[20] over



50 μm

a. Control, Unannealed (≈160X)



50 μm

b. Annealed, 75° C for 65 hr. (≈160X)

Figure 29. Micrographs of the Cut Surface of 2R-16 JAX Propellant

Table 7. Thermogravimetric Analysis for JA2, M30 and M43 at 60° C and 100° C

Propellant Specimen	(%Wt. Loss)	
	T= 60° C t = 1000 min	T= 100° C t = 360 min
JA2	13.5	19
M30	7.5	12
M43	1.5	3

Table 8. Vapor Pressures of Neat DEGDN and NG

Temperature (° C)	Vapor Pressure (Pa)	
	DEGDN	NG
20	0.48	0.20
25	0.78	0.24
40	no data	1.00
45	no data	1.72
60	17.3	8.00

the temperature range 20° to 60° C. The neat vapor pressure of DEGDN is significantly greater than that of NG, a factor of 2 at 60° C, and the weight percentage of DEGDN is almost a factor of 2 greater than the weight percentage of NG in the formulation of JA2. These two ratios lead us to focus our attention on DEGDN as the principal solvent for the transport of RDX in the JAXs.

The next question concerns the solubility of RDX in DEGDN itself. Table 9 shows the available data for the solubility of RDX and HMX[20] at 25° C. The data are ranked according to the value of the absolute solubility of RDX. This value ranges from a low of 2.3 g/100 g solvent to a high of 41 g/100 g solvent. The absolute solubility of RDX in neat DEGDN has the lowest value.

Since DEGDN is about 25 wt% of JA2, and since 6 to 30 wt% of RDX is added to the JA2, the solution of dissolved RDX in the DEGDN and NG within the JAX propellant is very likely saturated.

4.7 The RDX Deposition Process.

The measurable solubility of RDX in DEGDN and high vapor pressures for DEGDN strongly supports the following deposition process.

When RDX is added to the JA2 propellant, it dissolves to form a saturated solution in the propellant plasticizers. This accounts for smaller than expected particle sizes observed in morphology investigations, especially at lower concentrations of RDX. The high vapor pressure of DEGDN causes rapid vaporization of the plasticizer at all exposed propellant surfaces. During annealing, this process is accelerated (and the solubility of RDX may be greater) causing rapid loss of plasticizer and transport of RDX from the interior to the exterior surfaces. As the plasticizer vaporizes, the dissolved RDX precipitates and is deposited on the surface. Once crystals are formed on the surface, the tendency to enlarge existing crystals would take precedence over the creation of new sites, as is usually the case when solids precipitate from saturated solutions. This was observed in the most recent annealing experiments (see Section 4.5). The effect of this process is to remove RDX from the bulk of the grain and deposit RDX crystals on the exterior surfaces.

Table 9. Solubility of RDX and HMX in DEGDN at 25° C

Solvent	RDX	HMX	Ref	RDX/HMX
	(g/100g Solvent)			
DEGDN	2.3	<0.2	a	>11
Acetonitrile	5.5	2.0	b	2.8
Cyclohexanone	7.7	1.0	b	7.7
Acetone	8.2	2.8	b	2.9
Butyrolactone	14	12	b	1.2
Hexamethyl phosphoramide	16	1.4	b	11
Dimethyl acetamide	33	c	b	---
Dimethyl formamide	37	c	b	---
Dimethyl sulfoxide	41	57	b	0.7

a) Reference 18

b) CPIA/M3 "Solid Propellant Ingredients Manual" Nov 1989. RDX values from Unit 16, p15 of 21; HMX values from Unit 15, p16 of 22.

c) Shortly after the HMX dissolves, precipitation of solvate crystals occurs.

5. SAFETY IMPLICATIONS

Some of the final processing steps in the manufacture of JAX are conducted at elevated temperatures.[3] First, there is the "even-speed operation" conducted at 68° C that prepares the dough for carpet rolling. Second, the carpet rolls are conditioned at 66° C for a minimum of 30 hours. Finally after extrusion, trays of cut propellant are annealed for 6 hours at a temperature of 43° C. If our proposed mechanism for the precipitation of RDX on exposed propellant surfaces is correct, then it is likely that recrystallized RDX is formed in one or more of these processing steps. Thus, the recrystallized RDX constitutes a potential safety hazard even during its manufacture.

It is also noted[21] that "Microscopic examination of 2R12 and 2R16 propellant carpet rolls in storage at Radford (since 1986) confirmed the presence of unbound (recrystallized) RDX on the propellant surface."

We have noted in section 4.5 that the recrystallized RDX is likely to be mechanically loosened from the exposed exterior surfaces of JAX propellant. This was confirmed when recrystallized RDX

Table 10. Sensitivity Initiation Characteristics for JAX, JA2 and Neat RDX

Sample	Production Date	Total Volatiles (%)	RDX Content		Sample Thickness (mm)	Impact (cm)	Sliding Friction* (MPa)	Electrostatic Dischsrge (J)	Thermal Initiation (°C)
			Particle Size (μ)	(%)					
2R12	Apr-86	0.05	47	12	2.46	80	390	≥9.5	198
2R16	Apr-86	<0.01	7.5	16	2.54	64	464	≥9.5	194
2R20	Feb-86	0.14	100	20	2.41	80	503	≥9.5	no data
JA2	Oct-86	0.30	0	0	2.46	80	617	≥9.5	195
neat RDX		dry	7.5	100	0.18-0.38	13-26	200-293	0.026-0.065	no data
neat RDX		dry	47	100	0.38-0.45	51	170	0.065	no data
neat RDX		dry	100	100	0.28-0.36	26-64	170-345	0.13-0.26	no data

** at 244 cm/s*

was easily removed from 2R12 and 2R16 carpet rolls in experiments at Radford by scraping the propellant surfaces with a spatula.[21]

This RDX crystal growth and subsequent separation from the propellant introduce safety concerns during propellant moving and handling operations that are not well understood. These concerns arise during sample inspection, the finishing phases in the JAX manufacturing process, and propellant shipment and storage.

Recent safety testing of several JAXs, JA2, and neat RDX has been done.[21] These results for threshold initiation levels are presented in Table 10. (In the table, threshold initiation level is defined as that level above which initiation can occur, and is established by 20 consecutive failures at the stated level. Initiation was determined by infrared detection of decomposition gases.) These data show little or no change in the initiation level among the JAXs as measured by electrostatic or thermal ignition. The differences in the JAX initiation values for impact and sliding friction were judged not significant. The report concludes that for all practical purposes the JAX initiation levels are comparable to the JA2 values. Table 10 also shows that dry, neat RDX is more easily initiated by impact, friction, and electrostatic discharge than either JA2 or the JAX propellants listed.

There are two implications that can be drawn from these data. First, the recrystallized RDX, when mechanically freed from the JAX, may either remain airborne and diffuse, or be convectively transported, thereby contaminating shipping or storage containers. The precise safety implications have not been quantified, but the data in Table 10 suggest a prudent caution since the loose RDX poses an increased safety hazard. Second, the fact that these safety tests showed no differences between JA2 and JAX (with or without surface RDX[21]) suggests that these tests cannot be used to predict or determine the level of recrystallized RDX present. To make this determination, a time-temperature study of the rate of formation of recrystallized RDX on the JAX propellant surfaces would have to be undertaken, perhaps as a function of the weight percentage of RDX. Once this relationship is determined, the temperature history of the JAX propellants would have to be recorded and evaluated to properly assess the current state of recrystallization. The increased hazard due to the evolution of loose RDX would also have to be determined.

Two considerations raise questions that may be significant, but are currently not resolvable. The first deals with the RDX deposition process at annealing and upper-extreme storage temperatures. The data in Table 8 show that the relationship between the vapor pressure and temperature is Arrhenius in nature. Thus, at elevated temperatures, the vapor pressures will continue to rapidly increase. However, the solubility of RDX in the propellant plasticizers is not known at higher temperatures. If the solubility is significantly larger and works in concert with the higher vapor pressure, the deposition rate will be markedly increased as the temperature rises. The second consideration concerns the deposition rate and is chemical in nature. Our interest has been focused on the role of DEGDN because of: 1) its higher vapor pressure (Table 8) and greater concentration relative to NG; and 2) the greater thermogravimetric weight loss experienced by JA2 relative to M30 (Table 7). Nevertheless, the role that NG plays in the RDX transport process is not clear. In addition, the mixture of DEGDN and NG that forms the JA2 plasticizer may have properties different from the properties of the neat components. Most of the information needed to address these concerns is not known. Two tacit assumptions were used throughout this analysis: 1) dramatic changes in the solubility of RDX with temperature were not considered; and 2) the vapor pressure of the plasticizer mixture would be an interpolation of the neat constituent values. If additional processes or chemical changes were introduced when the plasticizers were mixed, other explanations for these observations become possible. However, the mechanism, as presented, is qualitatively consistent with the information and physical data contained in this report.

In conclusion, the mechanism for the precipitation of RDX discussed in section 4.7 *produces a dynamically changing structure on the surfaces of and within JAX propellants. Since JAXs can undergo morphological changes with time and temperature, and since the standard safety tests are not predictors of the changing state of a JAX propellant, the continued manufacture and use of JAXs as they are currently formulated and processed is not recommended.*

6. OPTIONAL STRATEGIES TO RDX ADDITION

6.1 Solid Fills.

RDX is not the only energetic solid oxidizer that could be tried in the manufacture of a JAX-like propellant. Table 9 shows that the relative solubility of HMX in neat DEGDN is more than an order of magnitude lower than that of the RDX's solubility. While this is encouraging, this low value is no guarantee that HMX would not show a similar crystallization phenomenon. Recourse must be made to experimentation. Other solid oxidizers could also be tried.

6.2 Use of Less Volatile Plasticizer.

The DEGDN could either be replaced with a less volatile plasticizer or an inhibitor could be added to DEGDN to retard its migration. In this last regard, some experimentation with PARAPLEX G59, a viscous, high molecular weight hydrocarbon, has shown some success.[22] Approximately 10 wt% of G59 had been added to a recently manufactured nominal 2R20 JAX. The grains were exposed to testing as described in section 4.5, except that the heating at 75° C was continued for 120 hours. These grains were examined by SEM, as described in section 4.3, and analyzed by FTIR, as described in section 4.4. No crystalline RDX was observed on the exposed outer surfaces.

7. SUMMARY

The original goal of this investigation, to determine the mechanism(s) by which the vulnerability response of JAX was so much greater than that of JA2, was not reached. It may be that the raw crystalline RDX observed on the external JAX surfaces contributes to this increased violent response but it is not the only possible mechanism, and in no way has it been demonstrated. For example, the implication that RDX enters into solution in the DEGDN may also provide a mechanism for the increase violent response of the JAXs observed in the vulnerability tests.

During the course of routine investigations on JAX propellant, raw RDX crystals were found deposited on the external surfaces of all JAX grains examined. A mechanism for this deposition was hypothesized and tested, and found to be consistent with all data at hand. Safety implications of the deposition process were pointed out and some general approaches to mitigating or circumventing the RDX crystallization were suggested.

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APPENDIX A

JAX Propellant Description Sheets

Lot Numbers:

HCL86H003-008
HCL86H003-009
HCL86H003-010
HCL86H003-013
HCL86H003-014
HCL86H003-015

HCL86C004-001
HCL86C004-002
HCL86C004-003
HCL86C004-004
HCL86C004-005
HCL86C004-006

HCL86C006-001
HCL86C006-002
HCL86C006-003
HCL86C006-004
HCL86C006-005

HCL86H008-001
HCL86H008-002
HCL86H008-003
HCL86H008-004
HCL86H008-005
HCL86H008-006
HCL86H008-007
HCL86H008-008

HCL87A010-002
HCL87A010-004
HCL87A010-005
HCL87A010-006
HCL87C010-007
HCL87C010-008
HCL87C010-009
HCL87C010-010
HCL87C010-011
HCL87C010-012
HCL87C010-013
HCL87C010-014
HCL87B010-015

RAD-PD-090-1(JA2)
RAD-PD-090-2
RAD-PD-090-3
RAD-PD-090-4

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N/A	450 Pounds
RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Honeywell Subcontract 947092

B95089; 95091; 95092

MAX 13.11 %		
MIN 13.07 %		
AVG 13.10 %	45+ MIN	30+ MIN

MANUFACTURE OF SOLVENTLESS PROPELLANT

ROOM	HR	PROCESS-DRYING	DAYS	HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION CONSTITUENT	FORMULA	ALLOWABLE TOLERANCE	ACTUAL	STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	50.64	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	11.45	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	19.24	FORM OF PROPELLANT		
Akardit II	N/A	N/A	0.71	HOF (cal/gm)	N/A	1163
Magnesium Oxide	N/A	N/A	0.05	Abs. Dens. (g/cc)	N/A	1.61
Graphite	N/A	N/A	0.05	Taliani:		
RDX	N/A	N/A	17.78	Slope @ 100 mm Hg	5% Or'/min	.349
Ash	N/A	N/A	0.09			
Moisture	0.5	±0.3	0.2			
Methylene Cl Solubility	N/A	N/A	31.40			

CLOSED BOMB

	LOT NUMBER	TEMP °F	BURNING RATE	BURNING FORCE
MIN		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	90	MAX DEV	MAX DEV

REMARKS

The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700 cc bomb, 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS

	SPECIFICATION	MIN	MEASURED
LENGTH (L)	N/A	.648	.656
DIAMETER (D)	N/A	.620	.601
PERF DIA (d)	N/A	.027	.027
Web Ave	N/A	.082	.079
Inner	N/A	.088	.078
Middle	N/A	.091	.076
Outer	N/A	.067	.082
L/D	N/A		2.77
L/d	N/A	1.05	1.09
D/d	N/A	22.96	22.69

DATES
PACKED 8/86
SAMPLED 8/86
TEST FINISHED 8/86

TYPE OF PACKING CONTAINER: Fiber Drum; 652 D

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

2R-20 19 part granular | DNR | HCL86H003-008

PROPELLANT DESCRIPTION SHEET

EXEMPT-PARA 7-2a AR 335-15

COMPOSITION: 2R20, 19 Perf Hexagonal Granular
SPECIFICATION: Honeywell Multics SFB 086-057 & SFB 086-081
LOT NUMBER: HCL86H003-005
PACKED AMOUNT: 488 Pounds
MFG AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.
CONTRACT NUMBER: Honeywell Subcontract 947092, KE, TASK 110

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	AI STARCH (65.5°C)	STABILITY (134.5°C)
B95089; B95091; B95092	MAX 13.13 %	MIN	MIN
	MIN 13.07 %	MIN	MIN
	AVG 13.10 %	45+ MIN	30+ MIN
			EXPLOSION NR

MANUFACTURE OF SOLVENTLESS PROPELLANT

PERCENTAGE SOLVENT TO WHOLE

TEMPERATURES ° FROM	TO	PROCESS—DRYING	TIME DAYS	HOURS
		N/A		

PROPELLANT COMPOSITION — TESTS OF FINISHED PROPELLANT — STABILITY AND PHYSICAL TESTS

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	TESTS	FORMULA	ACTUAL
NITROCELLULOSE	N/A	N/A	50.64	HEAT Test @ 120°C	CC 40'	CC 60'+
NITROGLYCERIN	N/A	N/A	11.45	NO FUMES	NF 1 Hour	NF 1 Hour
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24	FORM OF PROPELLANT		
AKARDIT II	N/A	N/A	0.71	*TALIANI	21.0 MF/GM	
MAGNESIUM OXIDE	N/A	N/A	0.05		[illegible]	0.349
GRAPHITE	N/A	N/A	0.05	MOE (cal/gm)	N/A	1163
RDX	N/A	N/A	17.78			
ASH	N/A	N/A	0.09	ABS DENSITY (g/cc)	N/A	1.61
MOISTURE	N/A	N/A	0.2			
METHYLENE Cl SOLUBILITY	N/A	N/A	31.60			

CRESSED BOMB — PROPELLANT DIMENSIONS (inches)

TEST	LOT NUMBER	TEMP °F	Relative Force	PARAMETER	SPECIFICATION	DIE	FINISHED	Std. Dev. on % of Mean Dimensions SPEC	ACTUAL
				LENGTH (L)	N/A	0.660	0.666		
				DIAMETER (D)	N/A	0.639	0.612		
				PERF. DIA. (d)	N/A	0.024	0.024		
STANDARD			100.00%	Web Avg.	N/A	0.088	0.084		
				Inner	N/A	0.104	0.094		
				Middle	N/A	0.096	0.080		
				Outer	N/A	0.064	0.079		
				Web Diff./					
				SD in % of					
				Web Avg.	N/A		1.63		
				L:D	N/A	1.03	1.09		
				D:d	N/A	26.62	25.96		

DATES
PACKED 8/86
SAMPLED 8/86
TEST FINISHED 8/86
OFFERED
DESCRIPTION SHEETS FORWARDED 9/30/86

REMARKS: NO DATA AVAILABLE

TYPE OF PACKING CONTAINER: FIBER DRUMS: MIL-STD-652D

REMARKS
Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

D. W. KIRKPATRICK, PROCESS ENGINEER

R. L. SIMMONS, PROGRAM MANAGER

ARRCOM FORM 214R 10 AUG 77

N/A	497 Pounds	
RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Honeywell Subcontract 947092	
B95089; 95091; 95092		

MAX 13.11 %		
MIN 13.07 %		
AVG 13.10 %	45+	30+

MANUFACTURE OF SOLVENTLESS PROPELLANT

Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

Constituent					Formula	Actual
Nitrocellulose	N/A	N/A	50.64	Heat Test @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	11.45	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	19.24	Form of Propellant		
Akardit II	N/A	N/A	0.71	HOF (cal/gm)	N/A	1163
Magnesium Oxide	N/A	N/A	0.05	Abs. Dens. (g/cc)	N/A	1.61
Graphite	N/A	N/A	0.05	Taliani:		
2NX	N/A	N/A	17.78	Slope @ 100 mm Hg	≤1.0 cc/min	.349
Ash	N/A	N/A	0.09			
Moisture	0.5	±0.3	0.2			
Methylene Cl Solubility	N/A	N/A	31.40			

	Lot Number	Temp °F	Average Burning Rate	Average Pressure
Min		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
Standard	S-231	90		

Remarks

The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700 cc bomb, 0.1 gm/cc loading density.

	Specification	Min	Average
Length (L)	N/A	.660	.670
Diameter (D)	N/A	.639	.617
Perf. Dia. (d)	N/A	.020	.021
Web Ave	N/A	.090	.086
Inner	N/A	.106	.091
Middle	N/A	.093	.078
Outer	N/A	.0655	.090
L/D	N/A	1.03	1.09
Web/d	N/A	31.95	29.18
	N/A		6.66

Dates: Packed 8/86; Sampled 8/86; Test Finished 8/86

Type of Packing Container: Fiber Drum: 652 D

Remarks: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

2R-20 19 perf grain lot HCLB6H003-010

COMPOSITION: 2R10, 19 Perf. Hexagonal Granular	LOT NUMBER: RCL86H003-013
SPECIFICATION: Multics GER 086-323, 5/27/86	PACKED AMOUNT: 173 Pounds
MFG AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 973525, Task III

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	EU STARCH (65.5°C)	STABILITY (134.5°C)
B95089; B95091; B95092	MAX 13.13 %	MIN	MIN
	MIN 13.07 %	MIN	MIN
	AVG 13.10 %	45+ MIN	30+ MIN
			EXPLOSION

MANUFACTURE OF SOLVENTLESS PROPELLANT

PROCESS-DRYING

TEMPERATURE °F FROM	TO		TIME DAYS	HOURS

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION: CONSTITUENT	FORMULA	TOLERANCE	MEASURED
Nitrocellulose	N/A	N/A	55.09
Nitroglycerin	N/A	N/A	12.68
DEGDN	N/A	N/A	20.99
Akardit II	N/A	N/A	0.61
Magnesium Oxide	N/A	N/A	0.06
Graphite	N/A	N/A	0.05
RDX	N/A	N/A	10.52
Ash	N/A	N/A	0.10
Moisture	N/A	N/A	0.4
Methylene Cl Solubility	N/A	N/A	34.28

STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
HEAT TEST @ 120°C	CC 40'	CC 60'+
No Fumes	NF 1 hr	NF 1 Hr
FORM OF PROPELLANT		
BOF (cal/gm)	N/A	1156
Abs. Dens. g/cc	N/A	1.60
Taliani:		0.353
Slope @ 100 mg	1.0 gm/min	
		.0[illegible]

[illegible] PROPELLANT ON FIRING [illegible]

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE
TEST				
	-013	-40	105.45	104.19
	-013	+90	119.89	105.02
	-013	+145	123.47	104.86
STANDARD	472-138	90	100.00%	100.00%

	SPECIFICATION	DIE	FINISHED
LENGTH (L)	N/A	.715	.715
DIAMETER (D)	N/A	.639	.610
PERF. DIA. (d)	N/A	.024	.022
Web Avg.	N/A	.088	.084
Inner	N/A	.104	.092
Middle	N/A	.096	.080
Outer	N/A	.064	.079
Web Dimension Coef. Var. in % of Web Avg.	N/A	[illegible]	6.76
LD	N/A		1.17
Dod	N/A	26.62	27.55

DATES
PACKED 8/86
SAMPLED 8/86
TEST FINISHED 8/86
OFFERED 9/11/86
DESCRIPTION SHEETS FORWARDED

REMARKS
The 2R10 was in sheet form (7.5" x .125" x .085") fired against the XM829 standard PE 472-138.

700cc bomb @ 0.10 gm/cc loading density.

TYPE OF PACKING CONTAINER: Fiber Drum: 652D

REMARKS
Candelilla wax was used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE
D. W. KIRKPATRICK D W Kirkpatrick

R. L. SIMMONS, PROGRAM MANAGER

PROPELLANT DESCRIPTION SHEET

AR 385-16

COMPOSITION: 2R10, 19 Perf. Hexagonal Granular	LOT NUMBER: HCL86H003-014
SPECIFICATION: Multics GER 086-323, 5/27/86	PACKED AMOUNT: 768 Pounds
MFG AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 973525, Task III

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	EU STABILITY (65.5°C)	STABILITY (120°C)
B95089; B95091; B95092	MAX 13.13 %	____ MIN	____ MIN
	MIN 13.07 %	____ MIN	____ MIN
	AVG 13.10 %	45+ MIN	30+ MIN
			EXPLOSION ___

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F FROM	TO	PROCESS-DRYING	TIME DAYS	TIME HOURS

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT ANALYZED	STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	55.09	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	12.68	No Fumes	NF 1 hr	NF 1 Hr.
DEGDN	N/A	N/A	20.99	BOMB OF PROPELLANT		
Akardit II	N/A	N/A	0.61	HOF (cal/gm)	N/A	1156
Magnesium Oxide	N/A	N/A	0.06	Abs. Dens. (g/cc)	N/A	1.60
Graphite	N/A	N/A	0.05	Taliani:		
RDX	N/A	N/A	10.52	Slope @ 10mmHg	≤1.0mm/min	0.353
Ash	N/A	N/A	0.10			
Moisture	N/A	N/A	0.4			
Methylene Cl Solubility	N/A	N/A	34.28			

FIRING DATA — PROPELLANT DIMENSIONS (INCHES)

	LOT NUMBER	TEMP °F	BALLISTIC QUICKNESS	BALLISTIC INDEX		SPECIFICATION	MIN	FINISHED
TEST	-014	-40	105.45	104.19	LENGTH (L)	N/A	.709	.710
	-014	+90	119.89	105.02	DIAMETER (D)	N/A	.639	.615
	-014	+145	123.47	104.86	PERF. DIA. (d)	N/A	.020	.022
					Web Avg.	N/A	.090	.085
STANDARD	472-138	90	100.00%	100.00%	Inner	N/A	.106	.092
					Middle	N/A	.099	.079
					Outer	N/A	.0655	.086
					Web Dimension Std. Dev. in % of Web Avg.	N/A		7.04
					L/D	N/A	1.11	1.15
					D/d	N/A	31.95	27.95

DATES
PACKED 8/86
SAMPLED 8/86
TEST FINISHED 8/86
OFFERED 9/11/86
DESCRIPTION SHEETS FORWARDED

REMARKS
The 2R10 was in sheet form (7.5" x .125" x .085") fired against the XM829 standard PE 472-138.

700cc bomb @ 0.10 gm/cc loading density.

TYPE OF PACKING CONTAINER: Fiber Drum: 652D

REMARKS: Candelilla wax was used as a lubricant during extrusion and may be present in the propellant in trace amounts. The physical dimensions of this lot are a weighted average of sublots A and B.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE
D. W. KIRKPATRICK

R. L. SIMMONS, PROGRAM MANAGER

PROPELLANT DESCRIPTION SHEET

AR 385-15

COMPOSITION: 2R10-19 Perf. Hexagonal Granular	QA LOT NUMBER: HC-86H003-015
SPECIFICATION: Multics GER 086-223, 5/27/86	PACKED AMOUNT: 440 Pounds
MFG AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER AND/OR DATE: Subcontract 973525, Task III

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	EU STABILITY (65.5°C)	STABILITY (65.5°C)
B95089; B95091; B95092	MAX 13.13 %	MIN	MIN
	MIN 13.07 %	MIN	MIN
	AVG 13.10 %	45+ MIN	30+ MIN
			EXPLOSION HR

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F FROM	TO	PROCESS-DRYING	TIME DAYS	HOURS

PROPELLANT COMPOSITION			TESTS OF FINISHED PROPELLANT		STABILITY AND PHYSICAL TESTS	
CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT OBTAINED		FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	55.09	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	12.68	No Fumes	NF 1 hr	NF 1 Hr.
DEGDN	N/A	N/A	20.99	FORM OF PROPELLANT		
Akardit II	N/A	N/A	0.61	HOF (cal/gm)	N/A	1156
Magnesium Oxide	N/A	N/A	0.06	Abs. Dens. (g/cc)	N/A	1.60
Graphite	N/A	N/A	0.05	Taliani:		
RDX	N/A	N/A	10.52	Slope @ 100 mm-Hg	≤1.0 mm/min	0.353
Ash	N/A	N/A	0.10			
Moisture	N/A	N/A	0.4			
Methylene Cl Solubility	N/A	N/A	34.28			

CLOSED BOMB | PROPELLANT BURNING RATE

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE VIVACITY		SPECIFICATION	SIZE	FINISHED
TEST	-015	-40	105.45	104.19	LENGTH (L)	N/A	.738	.735
	-015	+90	119.89	105.02	DIAMETER (D)	N/A	.700	.654
	-015	+145	123.47	104.86	PERF. DIA. (d)	N/A	.020	.022
STANDARD	472-138	90	100.00%	100.00%	Web Avg.	N/A	.100	.089
					Inner	N/A	.116	.094
					Middle	N/A	.108	.083
					Outer	N/A	.077	.091
					Web Dimensions Coef. Var. in % of Web Avg.	N/A	.005	4.84
					LD	N/A	1.05	1.12
					Bd	N/A	35	29.44

REMARKS
The 2R10 was in sheet form (7.5" x .125" x .085") fired against the XM829 standard PE 472-138.

700cc bomb @ 0.10 gm/cc loading density.

DATES
PACKED 8/86
SAMPLED 8/86
TEST FINISHED 8/86
OFFERED 9/11/86
DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Fiber Drum: 652D

REMARKS

Candelilla wax was used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE

D. W. KIRKPATRICK D W Kirkpatrick

R. L. SIMMONS R L Simmons

2B-20 19 Perf Stick	MCL86C004-001 ✓
N/A	500 Pounds
RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Honeywell Subcontract 932077

NITROCELLULOSE

RECEIVED LOAD NUMBERS	NITROGEN CONTENT	ID RATIO (86.8°C)	VISCOSITY (86.8°C)
B95058: 95059: 95060	MAX 13.15 %	MAX	MAX
	MIN 13.08 %	MIN	MIN
	AVG 13.11 %	45+ MIN	30+ MIN
			EXPLOSION SEC

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F		PROCESS-DRYING	TIME	
FROM	TO		DAYS	HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED		FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	42.70	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	13.12	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	23.16	FORM OF PROPELLANT		
Carbamite II	N/A	N/A	0.64	HOF (cal/gm)	N/A	1166
Magnesium Oxide	N/A	N/A	0.03	Abs. Dens. (g/cc)	N/A	1.62
Graphite	N/A	N/A	0.05	Taliani:		
RDX (ground)	20	N/A	20.30	Slope @ 100mmHg	1.0mm/min	*
				* pressure did not reach		
Moisture	N/A	N/A		100 mm Hg		
Ash	N/A	N/A	0.10			

CLOSED BOMB

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE
TEST				
		-40	102.99	104.97
		+90	118.06	106.86
		+145	121.83	106.92
STANDARD	PF-472-138	+90	100.00%	100.00%

REMARKS: These are the closed bomb results for carpet rolls cut to strips of dimensions 7.5"x.125"x.085". 700 cc bomb with a 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

	SPECIFICATION	SET	FINISHED
LENGTH (L)	N/A	8.0	8.0
DIAMETER (D)	N/A	.700	.678
PERF. DIA. (d)	N/A	.021	.023
Web I	N/A	.113	.092
Web M	N/A	.108	.087
Web O	N/A	.077	.104
Web A	N/A	.099	.094
Web Difference (Red Dev. in % of Web Avg.)	N/A		6.67
L/D	N/A	11.43	11.80
Bed	N/A	33.33	29.75

DATES
PACKED 3/86
SAMPLED 3/86
TEST FINISHED 3/86
CHECKED
DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

Development Engineer
D.W. Kirkpatrick
D. W. Kirkpatrick

N/A

60 POUNDS

RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.

Honeywell Subcontract 932077

R95058; 95059; 95060

NITROGEN CONTENT		HEAT TEST	STABILITY
MAX 13.15 %			
MIN 13.08 %			
AVG 13.11 %		45+	30+

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE FROM	TO	PROCESS-DRYING	DAYS	HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT ANALYZED	STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	42.70	Heat Test @ 120°C	CC 60'	CC 60'+
Nitroglycerin	N/A	N/A	13.12	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	23.16	FORM OF PROPELLANT		
Akardit II	N/A	N/A	0.64	HOE (cal/gm)	N/A	1166
Magnesium Oxide	N/A	N/A	0.03	Abs. Dens. (g/cc)	N/A	1.62
Graphite	N/A	N/A	0.05	Taliani:		
RDX (ground)	20	N/A	20.30	Slope @ 100mmHg	≤1.0mm/min	*
				* pressure did not reach 100 mm Hg		
Moisture	N/A	N/A				
Ash	N/A	N/A	0.10			

CLOSED BOMB

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE
STD				
		-40	102.99	104.97
		+90	118.06	106.86
		+145	121.83	106.92
STANDARD	PE-472-138	+90	100 PCT.	100 PCT.

REMARKS These are the closed bomb results for carpet rolls cut to strips of dimensions 7.5"x.125"x.085".
700 cc bomb with a 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (INCHES)

	SPECIFICATION	DRY	FINISHED
LENGTH (L)	N/A	2.75	2.68
DIAMETER (D)	N/A	.700	.678
PERF. DIA. (d)	N/A	.021	.023
Web I	N/A	.113	.092
Web M	N/A	.108	.087
Web O	N/A	.077	.104
Web A	N/A	.099	.094
% Difference Web Av. to & of Web Avg.	N/A		6.67
L/D	N/A	3.93	3.95
D/d	N/A	33.33	29.75

DATES

PACKED 3/86
SAMPLED 3/86
TEST FINISHED 3/86
SHIPPED
DISPOSITION SHEETS FORWARDED

TYPE OF PACKING CONTAINER Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

HCL 86C004-002

2R-20 (9 perf stick

Development Engineer
D.W. Kirkpatrick
D. W. Kirkpatrick

[illegible]	N/A	[illegible]	65 Pounds
MADE AT	RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER	Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN IN CC-[illegible]	[illegible] (65.5°C)	STABILITY (134.5°C)
95058; 95059; 95060	MAX 13.15 %	MIN	MIN
	MIN 13.08 %	MIN	MIN
	AVG 13.11 %	45+ MIN	30+ MIN
			EXPLOSION MIN

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE FROM	TO	PROCESS-DRYING	DAYS	HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT ANALYZED	STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	42.70	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	13.12	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	23.16	FORM OF PROPELLANT		
Akardit II	N/A	N/A	0.64	HOE (cal/gm)	N/A	1166
Magnesium Oxide	N/A	N/A	0.03	Abs. Dens. (g/cc)	N/A	1.62
Graphite	N/A	N/A	0.05	Taliani:		
RDX (ground)	20	N/A	20.30	Slope @ 100mmHg	≤1.0mm/min	*
				* pressure did	not reach	
Moisture	N/A	N/A		100 mm Hg		
Ash	N/A	N/A	0.10			

CLOSED BOMB

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE
TEST				
		-40	102.99	104.97
		+90	118.06	106.86
		+145	121.83	106.92
STANDARD	PT-472-138	+90	NO CUTS	NO CUTS

REMARKS These are the closed bomb results for carpet rolls cut to strips of dimensions 7.5"x.125"x.085".
700 cc bomb with a 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (Inches)

	SPECIFICATION	GREEN	FINISHED
LENGTH (IN)	N/A	1.6	1.6
DIAMETER (IN)	N/A	.700	.678
PERF. DIA. (IN)	N/A	.021	.023
Web I	N/A	.113	.092
Web M	N/A	.108	.087
Web O	N/A	.077	.104
Web A	N/A	.099	.094
Web Difference (Max. Dev. in % of Web Ave.)	N/A		6.67
L/D	N/A	2.29	2.32
D/d	N/A	33.33	29.75

DATES

PACKED 3/86
SAMPLED 3/86
TEST FINISHED 3/86
OFFERED
INSPECTION REPORTS FORWARDED

TYPE OF PACKING CONTAINER Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

2R-20 19 perf stick

ACL 80C 004-003

Development Engineer
D.W. Kirkpatrick
D.W. Kirkpatrick

2R-20 7 Port Stick	
N/A	60 Pounds
RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Honeywell Subcontract 932077

MISCELLANEOUS

LOT NUMBER	NITROGEN CONTENT	IN PLANT (65.5°C)	STABILITY (65.5°C)
85058; 85059; 85060	MAX 13.15 %	MIN	MIN
	MIN 13.08 %	MIN	MIN
	AVG 13.11 %	45+ MIN	30+ MIN
			EXPLOSION HR

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F		PROCESS-DRYING	TIME	
FROM	TO		HRS	HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
CONSTITUENT	PERCENT FORMULA	PERCENT INGREDIENTS	PERCENT ANALYZED		FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	62.70	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	13.12	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	23.16	FORM OF PROPELLANT		
Akardit II	N/A	N/A	0.64	HOE (cal/gm)	N/A	1166
Magnesium Oxide	N/A	N/A	0.03	Abs. Dens. (g/cc)	N/A	1.62
Graphite	N/A	N/A	0.05	Taliani:		
RDX (ground)	20	N/A	20.30	Slope @ 100mmHg	0.0mm/min	*
				* pressure did not reach 100 mm Hg		
Moisture	N/A	N/A				
Ash	N/A	N/A	0.10			

FIRING DATA — **PHYSICAL DIMENSIONS (INCHES)**

	LOT NUMBER	TEMP °F	RELATIVE STRENGTH	RELATIVE QUICKNESS		SPECIFICATION	OK	REJECTED
TEST								
		-40	102.99	104.97	LENGTH (L)	N/A	15.0	15.0
		+90	118.06	106.86	DIAMETER (D)	N/A	.395	.391
		+145	121.83	106.92	PERF. DIA. (P)	N/A	.025	.0277
STANDARD	PP-472-138	+90	100.00%	100.00%	Webs			
					Inner	N/A	.081	.077
					Outer	N/A	.082	.077
					Ave.	N/A	.082	.077
					L/D	N/A	1.22	.04
					L/D	N/A	37.97	38.36
					D/d	N/A	15.8	14.65

DATES
PACKED 3/86
SAMPLED 3/86
TEST FINISHED 3/86
DISPATCHED
DESCRIPTION SHEETS FORWARDED

REMARKS: These are the closed bomb results for carpet rolls cut to strips of dimensions 7.5"x.125"x.085". 700 cc bomb with a 0.1 gm/cc loading density.

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

Development Engineer
D.W. Kirkpatrick
D. W. Kirkpatrick

COMPOSITION 2R-20 7 Perf Stick	LOT NUMBER BCLB6C004-005
SPECIFICATION N/A	WEIGHT MANUFACTURED 30 Pounds
MADE BY RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED LOTS NUMBERS	EXPLOSION CONTENT	@ 134.5°C	STABILITY @ 65.5°C
R95058; 95059; 95060	MAX 13.15 %	MIN	MIN
	MIN 13.08 %	MIN	MIN
	AVG 13.11 %	45+ MIN	30+ MIN
			EXPLOSION NO

MANUFACTURE OF SOLVENTLESS PROPELLANT

MIXER TEMP °F BOWL	MIXER TEMP °F JACKET	PROCESS-DRYING	TIME DAYS	TIME HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT ANALYSIS
Nitrocellulose	N/A	N/A	42.70
Nitroglycerin	N/A	N/A	13.12
DEGDN	N/A	N/A	23.16
Akardit II	N/A	N/A	0.64
Magnesium Oxide	N/A	N/A	0.03
Graphite	N/A	N/A	0.05
RDX (ground)	20	N/A	20.30
Moisture	N/A	N/A	
Ash	N/A	N/A	0.10

STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
HEAT TEST @ 120°C	CC 40'	CC 60'+
No Fumes	NF 1 hr	NF 1 hr
FORM OF PROPELLANT		
HOF (cal/gm)	N/A	1166
Abs. Dens. (g/cc)	N/A	1.62
Taliani:		
Slope @ 100mmHg	≯1.0mm/min	*
* pressure did not reach 100mmHg		

CLOSED BOMB

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE
STD				
		-40	102.99	104.97
		+90	118.06	106.86
		+145	121.83	106.92
STANDARD	PE-472-138	+90	100.00%	100.00%

REMARKS: These are the closed bomb results for carpet rolls cut to strips of dimensions 7.5"x.125"x.085". 700 cc bomb with a 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

	SPECIFICATION	SE	STANDARD
LENGTH (L)	N/A	15.0	15.0
DIAMETER (D)	N/A	.430	.422
PERF. DIA. (d)	N/A	.025	.026
Webs			
Inner	N/A	.093	.086
Outer	N/A	.087	.088
Ave.	N/A	.090	.087
Web Difference (Inner Web to Outer Web)	N/A	-6.90	2.57
L/D	N/A	34.88	35.54
D/d	N/A	17.20	16.23

DATES
PACKED 3/86
SAMPLED 3/86
TEST FINISHED 3/86
CHECKED
DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

Development Engineer
D.W. Kirkpatrick
D. W. Kirkpatrick

	2B-20 7 Port Stick		
	N/A	YIELDING AMOUNT	30 pounds
MFG AT	RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER	Honeywell Subcontract 932077

NITROCELLULOSE

RECEIVED LOTS NUMBERS	NITROGEN CONTENT	ES FILTRATE (85.5°C)	STABILITY (65.5°C)
R95058: 95059: 95060	BAR 13.15 %	____ min	____ min
	MIN 13.08 %	____ min	____ min
	AVG 13.11 %	45+ min	30+ min
			LIFROZEN

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F		PROCESS-DRYING	DAYS	HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT ALLOWED		FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	42.70	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	13.12	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	23.16	BURN OF PROPELLANT		
Akardit II	N/A	N/A	0.64	HOF (cal/gm)	N/A	1166
Magnesium Oxide	N/A	N/A	0.03	Abs. Dens. (g/cc)	N/A	1.62
Graphite	N/A	N/A	0.05	Taliani:		
RDX (ground)	20	N/A	20.30	Slope @ 100mmHg	@1.0mm/min	*
				* pressure did	not reach	
Moisture	N/A	N/A		100 mm Hg		
Ash	N/A	N/A	0.10			

CLOSED BOMB

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE
MIN				
		-40	102.99	104.97
		+90	118.06	106.86
		+145	121.83	106.92
STANDARD	PE-472-138	+90	100.00%	100.00%

REMARKS: These are the closed bomb results for carpet rolls cut to strips of dimensions 7.5"x.125"x.085". 700 cc bomb with a 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (INCHES)

	SPECIFICATION	MIN	MEASURED
LENGTH (L)	N/A	15.0	15.0
DIAMETER (D)	N/A	.471	.462
PERF DIA (d)	N/A	.025	.025
Webs			
Inner	N/A	.104	.101
Outer	N/A	.096	.093
Ave.	N/A	.100	.097
L/D Tolerance And Dev. in % of Web Ave.	N/A	-8.33	-8.23
L/D	N/A	31.85	32.47
D/d	N/A	18.84	18.48

DATES
PACKED 3/86
SAMPLED 3/86
TEST FINISHED 3/86
DATED
DISPOSITION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

Development Engineer
D.W. Kirkpatrick
D.W. Kirkpatrick

2R-20 19 Perf Stick			
N/A		399 pounds	
RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.		Honeywell Subcontract 932077	

B95058; 95059; 95060	MAX 13.15 %		
	MIN 13.08 %		
	AVG 13.11 %	45+ MIN	30+ MIN

MANUFACTURE OF SOLVENTLESS PROPELLANT

		PROCESS-DRYING		
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		
110°F	Ambient	Cool down for sampling		

PROPELLANT COMPOSITION — TESTS OF FINISHED PROPELLANT — STABILITY AND PHYSICAL TESTS

CONSTITUENT	FORMULA	TOLERANCE	ACTUAL
Nitrocellulose	N/A	N/A	42.68
Nitroglycerin	N/A	N/A	13.48
DEGDN	N/A	N/A	22.08
Akardit II	N/A	N/A	0.77
Magnesium Oxide	N/A	N/A	0.03
Graphite	N/A	N/A	0.04
RDX (class I)	20	N/A	20.92
Moisture	N/A	N/A	0.10
Ash	N/A	N/A	

	FORMULA	ACTUAL
HEAT TEST @ 120°C	CC 40'	CC 60'+
No Fumes	NF 1 hr	NF 1 hr
FORM OF PROPELLANT		
HOF (cal/gm)	N/A	1161
Abs. Dens. (g/cc)	N/A	1.62
Taliani:		
Slope @ 100mmHg	≤1.0mm/min	0.260

CLOSED BOMB — PROPELLANT DIMENSIONS (INCHES)

	LOT NUMBER	TEMP °F	BURNING RATE	BURNING TIME		SPECIFICATION	MIN	FINISHED
REF								
		-40	113.33	105.86	LENGTH (L)	N/A	8.0	8.0
		+90	123.05	107.30	DIAMETER (D)	N/A	.700	.675
		+145	124.88	106.28	PERF. DIA. (d)	N/A	.021	.022
STANDARD	PE-472-138	+90	MIN 80%	MAX 80%	Web I	N/A	.113	.102
					Web M	N/A	.108	.090
					Web O	N/A	.077	.093
					Web A	N/A	.099	.095
					Web Difference Max. Dev. in % of Web Size	N/A	•	4.95
					L/D	N/A	11.43	11.85
					D/d	N/A	33.33	30.68

REMARKS: These are the closed bomb results for carpet rolls cut to strips of dimensions 7.5"x.125"x.085". 700 cc bomb with a 0.1 gm/cc loading density.

DATES: PACKED 3/86; SAMPLED 3/86; TEST FINISHED 3/86; CERTIFIED; DESCRIPTION SHEET FOR WARHEAD

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

Development Engineer
D.W. Kirkpatrick
D. W. Kirkpatrick

N/A	
RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Honeywell Subcontract 932077

MIX BLOCK

BATCH NUMBERS	NITROGEN CONTENT	EU STABILITY (65.5°C)	STABILITY (65.5°C)
95058R; 95059; 95060	BAR 13.15 %		
	MIN 13.08 %		
	AVG 13.11 %	45+ MIN	30+ MIN
			EXPLOSION SEC

MANUFACTURE OF SOLVENTLESS PROPELLANT

PROCESS-DRYING

TEMPERATURE °F FROM	TO		TIME DAYS	TIME HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT ANALYSIS
Nitrocellulose	N/A	N/A	62.68
Nitroglycerin	N/A	N/A	13.48
DEGDN	N/A	N/A	22.08
Akardit II	N/A	N/A	0.77
Magnesium Oxide	N/A	N/A	0.03
Graphite	N/A	N/A	0.04
RDX (class I)	20	N/A	20.92
Moisture	N/A	N/A	0.10
Ash	N/A	N/A	

STABILITY AND PHYSICAL TESTS

	FORMULA	ACTUAL
HEAT TEST @ 120°C	CC 40'	CC 60'+
No Fumes	NF 1 hr	NF 1 hr
FORM OF PROPELLANT		
HOF (cal/gm)	N/A	1161
Abs. Dens. (g/cc)	N/A	1.62
Taliani:		
Slope @ 100mmHg	≤1.0mm/min	0.260

FUSED ROD

	LOT NUMBER	TEMP °F	BURNING RATE IN/SEC	BURNING RATE MM/SEC
MIN		-40	113.53	105.86
		+90	123.05	107.30
		+145	124.88	106.28
STANDARD	PE-472-138	+90	MIN 0.95	MIN 0.95

REMARKS: These are the closed bomb results for carpet rolls cut to strips of dimensions 7.5"x.125"x.085". 700 cc bomb with a 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (INCHES)

	SPECIFICATION	MIN	AVERAGE
LENGTH (L)	N/A	2.75	2.67
DIAMETER (D)	N/A	.700	.675
WEB DIA (W)	N/A	.021	.022
Web I	N/A	.113	.102
Web M	N/A	.108	.090
Web O	N/A	.077	.093
Web A	N/A	.099	.095
[illegible]	N/A		4.95
L/D	N/A	3.93	3.96
D/W	N/A	33.33	30.68

DATES
PACKED 3/86
SAMPLED 3/86
TEST FINISHED 3/86
SHIPPED
DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

2R-20 19pdf stick HCL86C006-002

Development Engineer
D.W. Kirkpatrick
D.W. Kirkpatrick

Propellant	2E-20 19 Perf Brick	Batch No.	
Specification	N/A	Weight Required	31 Pounds
Made at	RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Contract Number	Honeywell Subcontract 932077

NITROCELLULOSE

Batch Lot Numbers	Nitrogen Content	El Ether (65.5°C)	Stability (65.5°C)
895058; 95059; 95060	MAX 13.15 %	min	min
	MIN 13.08 %	min	min
	AVG 13.11 %	45+ min	30+ min
			Explosion no

MANUFACTURE OF SOLVENTLESS PROPELLANT

Temperature °F Beg.	Temperature °F End	PROCESS-DRYING	Time Days	Time Hours
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

Propellant Composition: Constituent	Percent Formula	Percent Ingredients	Percent As Loaded	Stability and Physical Tests	Formula	Actual
Nitrocellulose	N/A	N/A	42.68	Heat Test @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	13.68	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	22.08	Form of Propellant		
Akardit II	N/A	N/A	0.77	HOF (cal/gm)	N/A	1161
Magnesium Oxide	N/A	N/A	0.03	Abs. Dens. (g/cc)	N/A	1.62
Graphite	N/A	N/A	0.04	Taliani:		
RDX (class I)	20	N/A	20.92	Slope @ 100mmHg	@1.0mm/min	0.260
Moisture	N/A	N/A	0.10			
Ash	N/A	N/A				

BURNING RATE — PROPELLANT DIMENSIONS RECORD

Test	Lot Number	Temp °F	Effective Burning Rate	Effective Burning Rate		Specification	Set	Finished
		-40	113.53	105.86	Length (L)	N/A	1.6	1.6
		+90	123.05	107.30	Diameter (D)	N/A	.700	.675
		+145	124.88	106.28	Perf. Dia. (d)	N/A	.021	.022
Standard	PE-472-138	+90	100.00%	100.00%	Web I	N/A	.113	.102
					Web M	N/A	.108	.090
					Web O	N/A	.077	.093
					Web A	N/A	.099	.095
					Max Difference from Ave. in % of Web Ave.	N/A		4.95
					L/D	N/A	2.29	2.37
					Bpd	N/A	33.33	30.68

Remarks: These are the closed bomb results for carpet rolls cut to strips of dimensions 7.5"x.125"x.085". 700 cc bomb with a 0.1 gm/cc loading density.

Dates: Packed 3/86; Sampled 3/86; Test Finished 3/86; Checked; Description Sheets Forwarded

Type of Packing Container: Wood Box No. 327041, Barrier Bag No. 327041, Carton No. 327146

Remarks: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

Development Engineer
D.W. Kirkpatrick

D. W. Kirkpatrick

COMPOSITION 2R-20 7 Perf Stick

SPECIFICATION N/A

PROGRAM 30 Pounder

MADE AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.

CONTRACT NUMBER Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED LOTS NUMBERS: B95058; 95059; 95060

NITROGEN CONTENT	ED FLASH (65.5°C)	STABILITY (65.5°C)
MAX 13.15 %	____ MIN	____ MIN
MIN 13.08 %	____ MIN	____ MIN
AVG 13.11 %	45+ MIN	30+ MIN
		EXPLOSION ____ MIN

MANUFACTURE OF SOLVENTLESS PROPELLANT

MIXING MIX	MIX	PROCESS-DRYING	TIME DAYS	TIME HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION: CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT STANDARD
Nitrocellulose	N/A	N/A	42.68
Nitroglycerin	N/A	N/A	13.48
DEGDN	N/A	N/A	22.08
Akardit II	N/A	N/A	0.77
Magnesium Oxide	N/A	N/A	0.03
Graphite	N/A	N/A	0.04
RDX (class I)	20	N/A	20.92
Moisture	N/A	N/A	0.10
Ash	N/A	N/A	

STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
HEAT TEST @ 120°C	CC 40'	CC 60'+
No Fumes	NF 1 hr	NF 1 hr
FORM OF PROPELLANT		
HOF (cal/gm)	N/A	1161
Abs. Dens. (g/cc)	N/A	1.62
Taliani:		
Slope @ 100mmHg	≤1.0mm/min	0.260

CLOSED BOMB

	LOT NUMBER	TEMP °F	BRAVO (cal/gm)	BRAVO (KPSI)
MIL				
		-40	113.53	105.86
		+90	123.05	107.30
		+145	124.88	106.28
STANDARD	PE-472-138	+90	MIN MAX	MIN MAX

REMARKS: These are the closed bomb results for carpet rolls cut to strips of dimensions 7.5"x.125"x.085". 700 cc bomb with a 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (INCHES)

	SPECIFICATION	MIN	MEASURED
LENGTH (L)	N/A	15.0	15.0
DIAMETER (D)	N/A	.395	.387
PERF. DIA. (d)	N/A	.025	.026
Web:			
Inner	N/A	.081	.078
Outer	N/A	.082	.077
Ave.	N/A	.082	.077
% Eccentricity (Out Dev. in % of Web Ave.)	N/A	1.22	-1.51
L/D	N/A	37.97	38.76
D/d	N/A	15.80	14.88

DATES: PACKED 3/86; SAMPLED 3/86; TEST FINISHED 3/86; CHECKED; EXCEPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

2R20 7 perf stick HCL86C006-004 ✓

Development Engineer
D.W. Kirkpatrick
D W. Kirkpatrick

ZR-20 7 Perf Stick	
N/A	45 Pounds
RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Honeywell Subcontract 932077

NITROCELLULOSE

LOT NUMBERS	NITROGEN CONTENT	EU STABILITY (65.5°C)	STABILITY (65.5°C)
895058; 95059; 95060	MAX 13.15 %	MIN	MIN
	MIN 13.08 %	MIN	MIN
	AVG 13.11 %	45+ MIN	30+ MIN
			EXPLOSION MIN

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F		PROCESS-DRYING	TIME (HRS)	
FROM	TO		RAMP	HOLD
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT ANALYSIS		FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	42.68	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	13.48	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	22.08	FORM OF PROPELLANT		
Akardit II	N/A	N/A	0.77	HOF (cal/gm)	N/A	1161
Magnesium Oxide	N/A	N/A	0.03	Abs. Dens. (g/cc)	N/A	1.62
Graphite	N/A	N/A	0.04	Taliani:		
RDX (class I)	20	N/A	20.92	Slope @ 100mmHg	1.0mm/min	0.260
Moisture	N/A	N/A	0.10			
Ash	N/A	N/A				

CLOSED BOMB | **PROPERTIES OF GRAINS (Re888)**

	LOT NUMBER	TEMP °F	BURNING DURATION	BURNING RATE		SPECIFICATION	RE	FINISHED
TEST					LENGTH (L)	N/A	15.0	15.0
		-40	113.33	105.86	DIAMETER (D)	N/A	.471	.462
		+90	123.05	107.30	PERF DIA (d)	N/A	.025	.025
		+145	124.88	106.28	Webs			
STANDARD	PE-472-138	+90	100.00%	100.00%	Inner	N/A	.104	.101
					Outer	N/A	.096	.093
					Ave	N/A	.100	.097
					% Difference (Out. Dev. in % of Web Ave.)	N/A	-8.33	-8.23
					L/D	N/A	31.85	32.47
					D/d	N/A	18.84	18.57

DATES
PACKED 3/86
SAMPLED 3/86
TEST FINISHED 3/86
APPROVED
DESCRIPTION SHEETS FORWARDED

REMARKS: These are the closed bomb results for carpet rolls cut to strips of dimensions 7.5"x.125"x.085". 700 cc bomb with a 0.1 gm/cc loading density.

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

Development Engineer
D.W. Kirkpatrick
D. W. Kirkpatrick

COMPOSITION	2R-20 19 Perf Stick (JAX)	DA LOT NUMBER	NCL86H008-001
SPECIFICATION	N/A	PACKED AMOUNT	700 Pounds
MADE AT	RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER	Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
B95089; 95091; 95092			
	MAX 13.13 %	min	min
	MIN 13.07 %	min	min
	AVG 13.10 %	45+ min	30+ min
			EXPLOSION min

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE FROM	TEMPERATURE TO	PROCESS-DRYING	TIME DAYS	TIME HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION: CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	50.64	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	11.45	No Fumes	NF 1 hr	NF 1 hr
DEGDN			19.24	HEAT OF PROPELLANT		
Akardit II	N/A	N/A	0.71	HOF (cal/gm)	N/A	1163
Magnesium Oxide	N/A	N/A	0.05	Abs. Dens. (g/cc)	N/A	1.61
Graphite	N/A	N/A	0.05	Taliani:		
RDX	N/A	N/A	17.78	Slope @ 100mmHg	≤1.0mm/min	.349
Ash	N/A	N/A	0.09			
Moisture	0.5	±0.3	0.2			
Methylene Cl Solubility	N/A	N/A	31.40			

CLOSED BOMB

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE
TEST		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	90	100.00%	100.00%

REMARKS

The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700 cc bomb, 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (INCHES)

	SPECIFICATION	DIE	FINISHED
LENGTH (L)	N/A	8.0	8.0
DIAMETER (D)	N/A	.700	.683
PERF DIA (d)	N/A	.023	.024
Web Ave	N/A	.099	.094
Inner	N/A	.115	.093
Middle	N/A	.106	.081
Outer	N/A	.075	.107
Web Difference / Ext. Dev. in % of Web Ave	N/A		9.57
L/D	N/A	11.43	11.71
D/d	N/A	30.43	28.21

DATES	
PACKED	8/86
SAMPLED	8/86
TEST FINISHED	8/86
OFFERED	
DESCRIPTION SHEETS FORWARDED	

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

DWK J.W. [signature] 29 AUG 86

N/A	72 Pounds
RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Honeywell Subcontract 932077

INGREDIENTS

B95089; 95091; 95092	13.13 % / 13.07 % / AVG 13.10 %	45+	30+

MANUFACTURE OF SOLVENTLESS PROPELLANT

PROCESS-DRYING

BOA	ID		HRS	COUNT
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		
110°F	Ambient	Cool down for sampling		4

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION — CONSTITUENT	FORMULA	TOLERANCE	ANALYZED	STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	50.64	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	11.45	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	19.24	FORM OF PROPELLANT		
Akardit II	N/A	N/A	0.71	HOF (cal/gm)	N/A	1163
Magnesium Oxide	N/A	N/A	0.05	Abs. Dens. (g/cc)	N/A	1.61
Graphite	N/A	N/A	0.05	Taliani:		
RDX	N/A	N/A	17.78	Slope @ 100mmHg	1.0cm/min	.349
Ash	N/A	N/A	0.09			
Moisture	0.5	±0.3	0.2			
Methylene Cl Solubility	N/A	N/A	31.40			

CLOSED BOMB

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE
TEST		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	90	100.00	100.00

PROPELLANT DIMENSIONS (Inches)

	SPECIFICATION	SIZE	FINISHED
LENGTH (L)	N/A	2.68	2.70
DIAMETER (D)	N/A	.700	.683
WEB DIA. (W)	N/A	.023	.024
Web Ave	N/A	.099	.094
Inner	N/A	.115	.093
Middle	N/A	.106	.081
Outer	N/A	.075	.107
Web Dimension Not Out to 5 at Web Ave	N/A		9.57
L/D	N/A	3.83	3.95
L/W	N/A	30.43	28.21

DATES
PACKED 8/86
SAMPLED 8/86
TEST FINISHED 8/86
CERTIFIED
DESCRIPTION SHEETS FORWARDED

REMARKS

The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700 cc bomb, 0.1 gm/cc loading density.

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS

Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

DWZ

N/A	78 Pounds
BADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Honeywell Subcontract 932077

NITROCELLULOSE

LOT NUMBERS	NITROGEN CONTENT	% SOLUBLE IN ETHER	STABILITY (MAG°C)
B95089; 95091; 95092	MAX 13.13 %	MIN	MIN
	MIN 13.07 %	MAX	MAX
	AVG 13.10 %	45+ MAX	30+ MIN
			EXPLOSION NO

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F BOM	TEMPERATURE °F EOM	PROCESS-DRYING	TIME DAYS	TIME HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION — CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT OBTAINED
Nitrocellulose	N/A	N/A	50.64
Nitroglycerin	N/A	N/A	11.45
DEGDN	N/A	N/A	19.24
Akardit II	N/A	N/A	0.71
Magnesium Oxide	N/A	N/A	0.05
Graphite	N/A	N/A	0.05
RDX	N/A	N/A	17.78
Ash	N/A	N/A	0.09
Moisture	0.5	±0.3	0.2
Methylene Cl Solubility	N/A	N/A	31.40

STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
HEAT TEST @ 120°C	CC 40'	CC 60'+
No Fumes	NF 1 hr	NF 1 hr
FORM OF PROPELLANT		
HOF (cal/gm)	N/A	1163
Abs. Dens. (g/cc)	N/A	1.61
Taliani:		
Slope @ 100mmHg	≤1.0%/min	.349

FINISHED PROPELLANT GRAINS (BOM)

	LOT NUMBER	TEMP °F	WEAVE DIAMETER	WEAVE WIDTH
MIN		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	90	MAX OPEN	MAX OPEN

	SPECIFICATION	MIN	NUMBER
LENGTH IN	N/A	1.6	1.6
DIAMETER IN	N/A	.700	.683
WEB DIA IN	N/A	.023	.024
Web Ave	N/A	.099	.094
Inner	N/A	.115	.093
Middle	N/A	.106	.081
Outer	N/A	.075	.107
Web Dimension Not Acc. to S at Web Ave	N/A		9.57
Lab	N/A	2.29	2.34
Bal	N/A	30.43	28.21

DATES
PACKED 8/86
SHIPPED 8/86
TEST RESULTS @ 8/86
APPROVED
DESCRIPTION SHEETS FOR WAIVERS

REMARKS

The closed bomb test used 2R-20 in the 827 form fired against th 827 standard. 700cc bomb, 0.1 gm/cc loa ing density.

TYPE OF PACKING CONTAINER Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

DWC
10/8

2R-20 19 Perf Stick(TAX)	NCL86H008-004
N/A	324 Pounds
BAD BY RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Honeywell Subcontract 932077

ACCEPTED LOTS NUMBERS	MOISTURE CONTENT	IN PLANT (DAYS °F)	STABILITY (DAYS °C)
B95089; 95091; 95092	BAT 13.13 %		
	DRY 13.07 %		
	AVG 13.10 %	45+	30+
			EXPLOSION

MANUFACTURE OF SOLVENTLESS PROPELLANT

BOAT	AIR	PROCESS-DRYING	LEVEL	MOVED
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
CONSTITUENT	FORMULA	TOLERANCE	PERCENT ANALYZED		FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	50.64	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	11.45	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	19.24	POUR OF PROPELLANT		
Akardit II	N/A	N/A	0.73	HOF (cal/gm)	N/A	1163
Magnesium Oxide	N/A	N/A	0.05	Abs. Dens. (g/cc)	N/A	1.61
Graphite	N/A	N/A	0.05	Taliani:		
RDX	N/A	N/A	17.78	Slope @ 100mmHg	1.0mm/min	.349
Ash	N/A	N/A	0.09			
Moisture	0.5	±0.3	0.2			
Methylene Cl Solubility	N/A	N/A	31.40			

FLASH POINTS

	LOT NUMBER	TEMP °F	EXPLOSIVE CHARACTER	EXPLOSIVE POINT
TEST		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	90	MIN DEPT	MIN DEPT

REMARKS:

The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700 cc bomb, 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (INCHES)

	SPECIFICATION	DIE	FINISHED
LENGTH (L)	N/A	8.0	8.0
DIAMETER (D)	N/A	.700	.684
WEB DIA (W)	N/A	.054	.048
Web Ave	N/A	.073	.074
Inner	N/A	.074	.058
Middle	N/A	.073	.069
Outer	N/A	.072	.094
Web Difference (Not Over ½ of Web Ave)	N/A		.037
L/D	N/A	11.43	11.70
D/W	N/A	12.96	14.25

DATES

PACKED 8/86

SAMPLED 8/86

TEST FINISHED 8/86

SHIPPED

DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

DWK

N/A	44 Pounds
RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Honeywell Subcontract 932077

INTRODUCTION

ASSIGNED LOT NUMBERS	MOISTURE CONTENT	% VOLATILES (BASIS)	RESIDUAL SOLVENT (BASIS)
B95089; 95091; 95092	BAR 13.11 %		
	BOM 13.07 %		
	AVG 13.10 %	45+	30+ EXPLOSIVE

MANUFACTURE OF SOLVENTLESS PROPELLANT

BOM	BB	PROCESS-DRYING	DAYS	HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION — CONSTITUENT	PER CENT FORMULA	PER CENT FOUND	PER CENT CORRECTED
Nitrocellulose	N/A	N/A	50.64
Nitroglycerin	N/A	N/A	11.45
DEGDN	N/A	N/A	19.24
Akardit II	N/A	N/A	0.71
Magnesium Oxide	N/A	N/A	0.05
Graphite	N/A	N/A	0.05
3DX	N/A	N/A	17.78
Ash	N/A	N/A	0.09
Moisture	0.5	±0.3	0.2
Methylene Cl Solubility	N/A	N/A	31.40

STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
HEAT TEST @ 120°C	CC 60'	CC 60'+
No Fumes	NF 1 hr	NF 1 hr
FORM OF PROPELLANT		
HOF (cal/gm)	N/A	1163
Abs. Dens. (g/cc)	N/A	1.61
Taliani:		
Slope @ 100mmHg	≤1.0mm/min	.349

FIRING DATA

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE
BP		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	90	100	100

REMARKS

The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700 cc bomb, 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

	SPECIFICATION	DIE	FINISHED
LENGTH (L)	N/A	2.68	2.68
DIAMETER (D)	N/A	.700	.684
WEB DIA (W)	N/A	.054	.048
Web Ave	N/A	.073	.074
Inner	N/A	.074	.058
Middle	N/A	.073	.069
Outer	N/A	.072	.094
Web Difference (Max Dev. in % of Web Ave)	N/A		
L/D	N/A	3.83	3.92
D/W	N/A	12.96	14.25

DATES
PACKED 8/86
SAMPLED 8/86
TEST FINISHED 8/86
SHIPPED
DISPOSITION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

DWK

SPECIFICATION: N/A	QUANTITY ACCEPTED: 250 Pounds
MADE BY: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	[illegible]	STABILITY (134.5°C)
B95089; 95091; 95092	MAX 13.13 %	min	min
	MIN 13.07 %	min	min
	AVG 13.10 %	45+ min	30+ min
			EXPLOSION min

MANUFACTURE OF SOLVENTLESS PROPELLANT

PROCESS-DRYING

TEMPERATURE FROM	TO	PROCESS-DRYING	DAYS	HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT ANALYZED	STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	50.64	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	11.45	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	19.24	FORM OF PROPELLANT		
Akardit II	N/A	N/A	0.71	HOE (cal/gm)	N/A	1163
Magnesium Oxide	N/A	N/A	0.05	Abs. Dens. (g/cc)	N/A	1.61
Graphite	N/A	N/A	0.05	Taliani:		
RDX	N/A	N/A	17.78	Slope @ 100mmHg	≤1.0mm/min	.349
Ash	N/A	N/A	0.09			
Moisture	0.5	±0.3	0.2			
Methylene Cl Solubility	N/A	N/A	31.40			

CLOSED BOMB

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE
TEST		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	90	100.00%	100.00%

REMARKS

The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700 cc bomb, 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (INCHES)

	SPECIFICATION	DIE	FINISHED
LENGTH (L)	N/A	15.0	15.0
DIAMETER (D)	N/A	.395	.391
PERF DIA (d)	N/A	.024	.027
Web Ave.	N/A	.081	.078
Inner	N/A	.0805	.076
Outer	N/A	.0815	.080
[illegible] of Web Ave.	N/A		4.79
L/D	N/A	37.97	38.36
D/d	N/A	16.46	14.39

DATES	
PACKED	8/86
SAMPLED	8/86
TEST FINISHED	8/86
SHIPPED	
DESCRIPTION SHEETS FORWARDED	

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

DWS

DESCRIPTION	2R-20 7 Perf Granular		
SPECIFICATION	N/A	ITEMS AMOUNT	209 Pounds
MFG BY	RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER	Honeywell Subcontract 932077

NITROCELLULOSE

LOT NUMBER	MOISTURE CONTENT	ALCOHOL INSOLUBLES	VISCOSITY (SECONDS)
B95089; 95091; 95092	BAR 13.13 % BIR 13.07 % AVG 13.10 %	45+ MIN	30+ MIN EXPLOSION NO

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F BOM	TEMPERATURE °F EOM	PROCESS-DRYING	TIME LOT	TIME EOM
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

PROPELLANT COMPOSITION — TESTS OF FINISHED PROPELLANT — STABILITY AND PHYSICAL TESTS

CONSTITUENT	WEIGHT % REQUIRED	WEIGHT % ALLOWED	WEIGHT % FOUND		FORMULA	ACTUAL
Nitrocellulose	N/A	N/A	50.64	HEAT TEST @ 120°C	CC 40'	CC 60'+
Nitroglycerin	N/A	N/A	11.45	No Fumes	NF 1 hr	NF 1 hr
DEGDN	N/A	N/A	19.24	BOMB OF PROPELLANT		
Akardit II	N/A	N/A	0.71	HOF (cal/gm)	N/A	1161
Magnesium Oxide	N/A	N/A	0.05	Abs. Dens. (g/cc)	N/A	1.61
Graphite	N/A	N/A	0.05	Taliani:		
RDX	N/A	N/A	17.78	Slope @ 100mmHg	Si.Dev/min	.349
Ash	N/A	N/A	0.09			
Moisture	0.5	±0.3	0.2			
Methylene Cl Solubility	N/A	N/A	31.40			

CLOSED BOMB — PROPELLANT DIMENSIONS (INCHES)

	LOT NUMBER	TEMP °F	BURNING RATE (IN/SEC)	BURNING RATE (IN/SEC)		SPECIFICATION	AS	AVERAGED
WF		-40	90.97	101.69	LENGTH (L)	N/A	.539	.547
		+90	92.47	103.43	DIAMETER (D)	N/A	.355	.354
		+145	96.81	104.25	PERF DIA (d)	N/A	.023	.022
STANDARD	S-231	90	MIN REQ	MIN REQ	Web Avg	N/A	.072	.072
					Inner	N/A	.0715	.068
					Outer	N/A	.0725	.077
					L/D	N/A	1.52	1.54
					Od	N/A	15.43	16.34

REMARKS

The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700 cc bomb, 0.1 gm/cc loading density.

DATES: PACKED 8/86; SAMPLED 8/86; TEST FINISHED 8/86; DATE SHIPPED; DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Fiber Drum; 652 D

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

DWL

2R-20 7 Perf Stick (JAX)	RCL86H008-008
N/A	300 Pounds
RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	Honeywell Subcontract 932077

LOT NUMBERS	EMULSION CONTENT	IN PROCESS (MM'S)	STABILITY (DAYS @ °C)
B95089; 95091; 95092	MAX 13.13 %		
	MIN 13.07 %		
	AVG 13.10 %	45+ MIN	30+ MIN
			EXPLOSION MIN

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE BOB	TEMPERATURE AIR	PROCESS-DRYING	DATE	HOURS
Ambient	Ambient	Load Forced Air Dry		
Ambient	110°F	Increase temperature to 110 ± 5°F		
110°F	110°F	Hold at temperature		4
110°F	Ambient	Cool down for sampling		

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION: CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT FOUND
Nitrocellulose	N/A	N/A	50.64
Nitroglycerin	N/A	N/A	11.45
DEGDN	N/A	N/A	19.24
Akardit II	N/A	N/A	0.71
Magnesium Oxide	N/A	N/A	0.05
Graphite	N/A	N/A	0.05
RDX	N/A	N/A	17.78
Ash	N/A	N/A	0.09
Moisture	0.5	±0.3	0.2
Methylene Cl Solubility	N/A	N/A	31.40

STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
HEAT TEST @ 120°C	CC 40'	CC 60'+
No Fumes	NF 1 hr	NF 1 hr
FORM OF PROPELLANT		
HOF (cal/gm)	N/A	1163
Abs. Dens. (g/cc)	N/A	1.61
Taliani:		
Slope @ 100mmHg	≥1.0mm/min	.349

CLOSED BOMB

	LOT NUMBER	TEMP °F	BURNING RATE (IN/SEC)	BURNING RATE (PSI)
TEST		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	90		

REMARKS:

The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700 cc bomb, 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (IN)

	SPECIFICATION	MIN	MEASURED
LENGTH (L)	N/A	15.0	15.0
DIAMETER (D)	N/A	.355	.354
WEB DIA (W)	N/A	.023	.022
Web Avg	N/A	.072	.072
Inner	N/A	.0715	.068
Outer	N/A	.0725	.077
VOLATILES AND MOISTURE	N/A		13.10
L/D	N/A	42.25	42.37
Od	N/A	15.43	16.34

DATES: PACKED 8/86; SAMPLED 8/86; TEST FINISHED 8/86; SHIPPED; DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

DWSK & TC

PROPELLANT DESCRIPTION SHEET

EXEMPT-PARA 7-2a

COMPOSITION: 2R-16 19 Perf Stick	DA LOT NUMBER: HCL87A010-002
SPECIFICATION: Honeywell Multiple GPR 087-002R	PACKED AMOUNT: 105 Pounds
MFD AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS: N95078; 95079; 95080; 95081; 95082

NITROGEN CONTENT	EI STABILITY (65.5 °C)	STABILITY (134.5 °C)
MAX ____ %	____ MINS.	____ MINS.
MIN ____ %	____ MINS.	____ MINS.
AVG 13.11 %	45+ MINS.	30+ MINS.
	____ MINS.	EXPLOSION ____ HRS

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F FROM	TO		TIME MINUTES	TIME HOURS
-	-	Blending	20	-
210	215	Differential Rolling	-	130
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION: CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED
NITROCELLULOSE	N/A	N/A	47.65
NITROGLYCERIN	N/A	N/A	13.10
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	22.21
AKARDITE II	N/A	N/A	0.75
MAGNESIUM OXIDE	N/A	N/A	0.08
GRAPHITE	N/A	N/A	0.06
RDX (Cyclotrimethylenetrinitramine)	N/A	N/A	16.15
TOTAL			100.00
Moisture	N/A	N/A	0.20

STABILITY AND PHYSICAL TESTS: TESTS	FORMULA	ACTUAL
HEAT	cc 40'	cc 60'+
NO FUMES	NF 1 Hr	NF 1 Hr
HOE cal/gm	N/A	1162
ABS DENSITY g/cc	N/A	1.61
Form of Prop.	Cyl	Cyl
No. of Perfs	19	19

CLOSED BOMB

TEST	LOT NUMBER	TEMP °F	KQ	RELATIVE FORCE
		-40	95.32	103.83
		+90	107.20	104.83
		+145	107.67	104.03
STANDARD	S-231	+90	100.00	100.00%

REMARKS: The closed bomb was shot using carpet roll cut into 7.5"x.125"x.09" strips.

PROPELLANT DIMENSIONS (Inches)

PARAMETER	SPECIFICATION	DIE	FINISHED	SPEC.	ACTUAL
LENGTH (L)	N/A	8.0	8.0	N/A	N/A
DIAMETER (D)	N/A	.700	.690	N/A	
PERF. DIA. (d)	N/A	.023	.021		
Web Ave.	N/A	.099	.097		
Outer	N/A	.075	.104		
Middle	N/A	.108	.086		
Inner	N/A	.115	.103		
Web Diff.	N/A	N/A	7.95		
L:D	N/A	11.43	11.59		
D:d	N/A	30.43	28.21		

DATES: PACKED 1/87; SAMPLED 1/87; TEST FINISHED 1/87; CLEARED; DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Carton 327310; Barrier Bag 327041; Wood Box 327311

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer: D. W. Kirkpatrick

PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYMBOL: EXEMPT-PARA 7-2a AR 231-1

COMPOSITION: 2R-20 19 Perf Stick	DA LOT NUMBER: HCLR7A010-004
SPECIFICATION: Honeywell Multrics GFR 087-002R	PACKED AMOUNT: 672 Pounds
MFG AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

ACCEPTED BLEND NUMBERS — NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	EU STABILITY (65.5°C)	STABILITY (134.5°C)
B95089; 95091; 95092	MAX 13.13 %	____ MINS.	____ MINS.
	MIN 13.07 %	____ MINS.	____ MINS.
	AVG 13.10 %	45+ MINS.	30+ MINS.
			EXPLOSION ____ HRS

TEMPERATURES °F		MANUFACTURE OF SOLVENTLESS PROPELLANT	TIME	
FROM	TO		MINUTES	SECONDS
-	-	Blending	20	-
210	215	Differential Rolling	-	140
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

PROPELLANT COMPOSITION — TESTS OF FINISHED PROPELLANT — STABILITY AND PHYSICAL TESTS

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	TESTS	FORMULA	ACTUAL
NITROCELLULOSE	N/A	N/A	50.64	HEAT	cc 40'	cc 60'+
NITROGLYCERIN	N/A	N/A	11.45	NO FUMES	NF 1 Hr	NF 1 Hr
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24			
AKARDIT II	N/A	N/A	0.71	°TALIANI	≤1.8 Kg/mm	.349
MAGNESIUM OXIDE	N/A	N/A	0.05		slope at 8mm	
GRAPHITE	N/A	N/A	0.05	HBE cal/gm	N/A	1163
RDX	N/A	N/A	17.78			
TOTAL			100.00	ABS DENSITY g/cc	N/A	1.61
Moisture	N/A	N/A	0.20			
Ash	N/A	N/A	0.09	Form of Prop.	Cyl	Cyl
Methylene Cl Solubility	N/A	N/A	31.40	No. of Perfs	19	19

CLOSED BOMB

	LOT NUMBER	TEMP °F	RQ	RELATIVE VIGOR
TEST		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	+90	100.00	100.00%

REMARKS: The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700cc bomb with 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

PARAMETER	SPECIFICATION	DIE	FINISHED	STD DEV. or % of Mean Dimension SPEC	STD DEV. or % of Mean Dimension ACTUAL
LENGTH (L)	N/A	8.0	8.0	N/A	N/A
DIAMETER (D)	N/A	.700	.690	N/A	N/A
PERF. DIA. (d)	N/A	.023	.021		
Web Ave.	N/A	.099	.097		
Outer	N/A	.075	.104		
Middle	N/A	.108	.086		
Inner	N/A	.115	.103		
Web Diff.	N/A	N/A	7.95		
L:D	N/A	11.43	11.59		
D:d	N/A	30.43	28.2		

DATES: .57 .7
PACKED 1/87
SAMPLED 1/87
TEST FINISHED 1/87
OFFERED
DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Carton 327310; Barrier Bag 327041; Wood Box 327311

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer: D. W. Shepherd

Program Manager: 9 FEB 87

ARRCOM FORM 214 R 10 AUG 77

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PROPELLANT DESCRIPTION SHEET

DEFENSE CONTROL SYMBOL: EXEMPT-PARA 7-2a AR 380-5

COMPOSITION: 2R-20 19 Perf Stick	DA LOT NUMBER: HCL87A010-005
SPECIFICATION: Honeywell Multica GEB 087-002R	PACKED AMOUNT: 672 Pounds
MFG AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS: B95089; 95091; 95092

NITROGEN CONTENT: MAX 13.13 %; MIN 13.07 %; AVG 13.10 %

EU STABON (65.5 °C): ____ MINS; 45+ MINS

STABILITY (134.5 °C): ____ MINS; ____ MINS; 30+ MINS; EXPLOSION ____ HRS

TEMPERATURE °F From	TEMPERATURE °F To	MANUFACTURE OF SOLVENTLESS PROPELLANT	TIME MINUTES	TIME SECONDS
-	-	Blending	20	-
210	215	Differential Rolling	-	140
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED
NITROCELLULOSE	N/A	N/A	50.64
NITROGLYCERIN	N/A	N/A	11.45
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24
AKARDIT II	N/A	N/A	0.71
MAGNESIUM OXIDE	N/A	N/A	0.05
GRAPHITE	N/A	N/A	0.05
RDX	N/A	N/A	17.78
TOTAL			100.00
Moisture	N/A	N/A	0.20
Ash	N/A	N/A	0.09
Methylene Cl Solubility	N/A	N/A	31.40

STABILITY AND PHYSICAL TESTS

TESTS	FORMULA	ACTUAL
HEAT	cc 40'	cc 60'+
NO FUMES	NF 1 Hr	NF 1 Hr
"TALIANI	≤1.8 Mg/mm Gloss at 100mm	.349
BOE cal/gm	N/A	1163
ABS DENSITY g/cc	N/A	1.61
Form of Prop.	Cyl	Cyl
No. of Perfs	19	19

CLOSED BOMB

TEST	LOT NUMBER	TEMP °F	RQ	RELATIVE FORCE
		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	+90	100.00	100.00%

REMARKS: The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700cc bomb with 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

PARAMETER	SPECIFICATION	BIE	FINISHED	SUB DIM. or % of Mean Dimensions SPEC	SUB DIM. or % of Mean Dimensions ACTUAL
LENGTH (L)	N/A	8.0	8.0	N/A	N/A
DIAMETER (D)	N/A	.700	.686	N/A	.93
PERF. DIA. (d)	N/A	.023	.021		
Web Ave.	N/A	.099	.097		
Outer	N/A	.074	.090		
Middle	N/A	.107	.100		
Inner	N/A	.116	.102		
Web Diff	N/A	N/A	5.34		
L:D	N/A	11.43	11.66		
D:d	N/A	30.43	32.15		

DATES: 31723
PACKED 1/87
SAMPLED 1/87
TEST FINISHED 1/87
OFFERED
DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Carton 327049 ; Barrier Bag 327202 ; Wood Box 327068

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer: D. W. Kilgore

Program Manager: [signature] 9 FEB 87

ARRCOM FORM 214 R 10 AUG 77

PROPELLANT DESCRIPTION SHEET

COMPOSITION: 2R-20 7 Perf Stick	BA LOT NUMBER: HCL87A010-006
SPECIFICATION: Honeywell Multica GEB 087-029	PACKED AMOUNT: 175 Pounds
APG AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	EU STARCH (65.5°C)	STABILITY (134.5°C)
B95089; 95091; 95092	MAX ____ % MIN ____ % AVG 13.10 %	____ MINS. 45+ MINS. ____ MINS.	____ MINS. 30+ MINS. EXPLOSION ____ HRS

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F From	TEMPERATURE °F To		TIME MINUTES	TIME SECONDS
-	-	Blending	20	-
210	215	Differential Rolling	-	140
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED
NITROCELLULOSE	N/A	N/A	50.64
NITROGLYCERIN	N/A	N/A	11.45
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24
AKARDIT II	N/A	N/A	0.71
MAGNESIUM OXIDE	N/A	N/A	0.05
GRAPHITE	N/A	N/A	0.05
RDX	N/A	N/A	17.78
TOTAL			100.00
Moisture	N/A	N/A	0.20
Ash	N/A	N/A	0.09
Methylene Cl Solubility	N/A	N/A	31.40

STABILITY AND PHYSICAL TESTS TESTS	FORMULA	ACTUAL
HEAT	cc 40'	cc 60'+
BO FUMES	NF 1 Hr	NF 1 Hr
FORM OF PROPELLANT		Cyl
°TALIANI	≤1.8 Mg/mm slope at 80mm	.349
BBE cal/gm	N/A	1163
ABS DENSITY g/cc	N/A	1.61

CLOSED BOMB

TEST	LOT NUMBER	TEMP °F	RO	RELATIVE FORCE
		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	+90	100.00	100.00

REMARKS: The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700cc bomb with 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

PARAMETER	SPECIFICATION	DIE	FINISHED	STD. DEV. or % of Mean Dimensions SPEC	STD. DEV. or % of Mean Dimensions ACTUAL
LENGTH (L)	N/A	3.0	3.0	N/A	N/A
DIAMETER (D)	N/A	.395	.386	N/A	1.57
PERF. DIA. (d)	N/A	.025	.026		
Web Ave.	N/A	.080	.077		
Outer	N/A	.081	.081		
Inner	N/A	.080	.073		
Web Diff.	N/A	N/A	10.44		
L:D	N/A	20.25	20.72		
D:d	N/A	15.80	14.70		

DATES
PACKED 1/87
SAMPLED 1/87
TEST FINISHED 1/87
OFFERED
DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Carton 327049 ; Barrier Bag 327202; Wood Box 327088

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer: D. W. Shumpert — W. R. Thomas

ARRCOM FORM 214 R 10 AUG 77

PROPELLANT DESCRIPTION SHEET

COMPOSITION: 2R-20 19 Perf Stick	DA LOT NUMBER: HCL87C010-007
SPECIFICATION: Honeywell Multics GFR 082-029	PACKED AMOUNT: 53 Pounds
MFD AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS: B95089; 95091; 95092

	Nitrogen Content	KI Starch (65.5°C)	Stability (134.5°C)
MAX	%	MINS	MINS
MIN	%	MINS	MINS
AVG	13.10 %	45+ MINS	30+ MINS
			EXPLOSION HRS

MANUFACTURE OF SOLVENTLESS PROPELLANT

Temperature °F From	To	Operation	Time Minutes	Seconds
-	-	Blending	20	-
210	215	Differential Rolling	-	140
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION / STABILITY AND PHYSICAL TESTS

Constituent	Percent Formula	Percent Tolerance	Percent Measured	Tests	Formula	Actual
NITROCELLULOSE	N/A	N/A	50.64	HEAT	cc 40'	cc 60'+
NITROGLYCERIN	N/A	N/A	11.45	NO FUMES	NF 1 Hr	NF 1 Hr
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24	FORM OF PROPELLANT		Cyl
AKARDIT II	N/A	N/A	0.71	TALIANI	≤1.0 mg/mm	.349
MAGNESIUM OXIDE	N/A	N/A	0.05		Slope at 100mm	
GRAPHITE	N/A	N/A	0.05	HOE cal/gm	N/A	1163
RDX	N/A	N/A	17.78			
TOTAL			100.00	ABS DENSITY g/cc	N/A	1.61
Moisture	N/A	N/A	0.20			
Ash	N/A	N/A	0.09			
Methylene Cl Solubility	N/A	N/A	31.40			

CLOSED BOMB

	Lot Number	Temp °F	RQ	Relative Force
TEST		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	+90	100.00	100.00%

REMARKS: The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700cc bomb with 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

Parameter	Specification	Die	Finished	Std. Dev. as % of Mean Dimensions Spec	Actual
Length (L)	N/A	4.75	4.78	N/A	N/A
Diameter (D)	N/A	.700	.690	N/A	N/A
Perf. Dia. (d)	N/A	.023	.021		
Web Ave.	N/A	.099	.097		
Outer	N/A	.075	.104		
Middle	N/A	.108	.086		
Inner	N/A	.115	.103		
Web Diff.	N/A	N/A	7.95		
L:D	N/A		6.93		
D:d	N/A	30.43	28.21		

DATES

- PACKED: 1/87
- SAMPLED: 1/87
- TEST FINISHED: 1/87
- OFFERED:
- DESCRIPTION SHEETS FORWARDED:

TYPE OF PACKING CONTAINER: Carton 327310; Barrier Bag 327041; Wood Box 327311

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer

D W Skyenter W. R. Gleones

RADFORM FORM 914 D 10 AUG 77

PROPELLANT DESCRIPTION SHEET

COMPOSITION: 2R-20 19 Perf Stick	DA LOT NUMBER: HCL87C010-008
SPECIFICATION: Honeywell Multica CPR 0R7- 029	PACKED AMOUNT: 67 Pounds
MFD AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	BI STARCH (65.5°C)	STABILITY (134.5°C)
B95089; 95091; 95092	MAX ____ %	____ MINS.	____ MINS.
	MIN ____ %	____ MINS.	____ MINS.
	AVG 13.10 %	45+ MINS.	30+ MINS.
			EXPLOSION ____ HRS

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F Min	TEMPERATURE °F Max		TIME (HR) Minimum	TIME (HR) Maximum
-	-	Blending	20	-
210	215	Differential Rolling	-	140
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED
NITROCELLULOSE	N/A	N/A	50.64
NITROGLYCERIN	N/A	N/A	11.45
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24
AKARDIT II	N/A	N/A	0.71
MAGNESIUM OXIDE	N/A	N/A	0.05
GRAPHITE	N/A	N/A	0.05
RDX	N/A	N/A	17.78
TOTAL			100.00
Moisture	N/A	N/A	0.20
Ash	N/A	N/A	0.09
Methylene Cl Solubility	N/A	N/A	31.40

STABILITY AND PHYSICAL TESTS

TEST	FORMULA	ACTUAL
HEAT	cc 40'	cc 60'+
BD FUMES	NF 1 Hr	NF 1 Hr
FORM OF PROPELLANT		Cyl
°ITALIANI	≤1.8 Kg/mm slope at 80mm	.349
BOE cal/gm	N/A	1163
ABS DENSITY g/cc	N/A	1.61

CLOSED BOMB

	LOT NUMBER	TEMP °F	RQ	RELATIVE FORCE
TEST		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-731	+90	100.00	100.00%

REMARKS: The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700cc bomb with 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

PARAMETER	SPECIFICATION	DIE	FINISHED	STD DEV. in % of Mean Dimension: SPEC	ACTUAL
LENGTH (L)	N/A	2.70	2.71	N/A	N/A
DIAMETER (D)	N/A	.700	.690	N/A	N/A
PERF. DIA. (d)	N/A	.023	.021		
Web Ave.	N/A	.099	.097		
Outer	N/A	.075	.104		
Middle	N/A	.108	.086		
Inner	N/A	.115	.103		
Web Diff	N/A	N/A	7.95		
L:D	N/A	3.86	3.93		
D:d	N/A	30.43	28.21		

.700 DATES
PACKED 1/87
SAMPLED 1/87
TEST FINISHED 1/87
OFFERED
DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Carton 327310; Barrier Bag 327041; Wood Box 327311

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer: D W Shuhgarter W.P. Thomas

ARRCOM FORM 214 R 10 AUG 77

PROPELLANT RECORD AND DATA SHEET

COMPOSITION: 2R-20 19 Perf Stick	LOT NUMBER: HCL87C010-009
SPECIFICATION: Honeywell Multiica CPR 087-029	PACKED AMOUNT: 54 Pounds
MFG AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS: B95089; 95091; 95092

NITROGEN CONTENT: MAX 13.13 %; MIN 13.07 %; AVG 13.10 %

EI STARCH (65.5°C): ____ MINS; ____ MINS; 45+ MINS

STABILITY (134.5°C): ____ MINS; ____ MINS; 30+ MINS; EXPLOSION ____ MIN

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMP °F FROM	TEMP °F TO		TIME (HR) MINUTES	TIME (HR) SECONDS
-	-	Blending	20	-
210	215	Differential Rolling	-	140
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

PROPELLANT COMPOSITION — TESTS OF FINISHED PROPELLANT — STABILITY AND PHYSICAL TESTS

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	TESTS	FORMULA	ACTUAL
NITROCELLULOSE	N/A	N/A	50.64	HEAT	cc 40'	cc 60'+
NITROGLYCERIN	N/A	N/A	11.45	BB FUMES	NF 1 Hr	NF 1 Hr
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24	FORM OF PROPELLANT		Cyl
AKARDIT II	N/A	N/A	0.71	*TALIANI	21.8 Kg/mm Slope at 100mm	.349
MAGNESIUM OXIDE	N/A	N/A	0.05			-
GRAPHITE	N/A	N/A	0.05	BBE cal/gm	N/A	1163
RDX	N/A	N/A	17.78			
TOTAL			100.00	ABS DENSITY g/cc	N/A	1.61
Moisture	N/A	N/A	0.20			
Ash	N/A	N/A	0.09			
Methylene Cl Solubility	N/A	N/A	31.40			

CLOSED BOMB

TEST	LOT NUMBER	TEMP °F	RQ	RELATIVE FORCE
		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	+90	100.00	100.00

REMARKS: The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700cc bomb with 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

PARAMETER	SPECIFICATION	DIE	FINISHED	STD DEV. or % of Mean Dimension: SPEC	ACTUAL
LENGTH (L)	N/A	2.10	2.13	N/A	N/A
DIAMETER (D)	N/A	.700	.690	N/A	N/A
PERF. DIA. (d)	N/A	.023	.021		
Web Ave.	N/A	.099	.097		
Outer	N/A	.075	.104		
Middle	N/A	.108	.086		
Inner	N/A	.115	.103		
Web Diff.	N/A	N/A	7.95		
L:D	N/A	3.00	3.09		
D:d	N/A	30.43	28.21		

DATES: PACKED 1/87; SAMPLED 1/87; TEST FINISHED 1/87; OFFERED; DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Carton 327310; Barrier Bag 327041; Wood Box 327311

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer: R W Fulgenzi W R Thomas

ARRCOM FORM 914 R 10 AUG 77

PROPELLANT DESCRIPTION SHEET

COMPOSITION: 2R-20 19 Perf Stick	DA LOT NUMBER: HCL87C010-010
SPECIFICATION: Honeywell Multics GFR 087-029	PACKED AMOUNT: 34 Pounds
MADE AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	EI STARCH (65.5°C)	STABILITY (134.5°C)
B95089; 95091; 95092	MAX ____ %	____ MINS	____ MINS
	MIN ____ %	45+ MINS	____ MINS
	AVG 13.10 %	____ MINS	30+ MINS
			EXPLOSION ____ HRS

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE FROM	TEMPERATURE TO		TIME MINUTES	TIME SECONDS
-	-	Blending	20	-
210	215	Differential Rolling	-	140
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	STABILITY AND PHYSICAL TESTS: TESTS	FORMULA	ACTUAL
NITROCELLULOSE	N/A	N/A	50.64	HEAT	cc 40'	cc 60'+
NITROGLYCERIN	N/A	N/A	11.45	NO FUMES	NF 1 Hr	NF 1 Hr
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24	FORM OF PROPELLANT		Cyl
AKARDIT II	N/A	N/A	0.71	*TALIANI	≤1.0 Hg/mm	.349
MAGNESIUM OXIDE	N/A	N/A	0.05		slope at 100 mm	
GRAPHITE	N/A	N/A	0.05	HOE cal/gm	N/A	1163
RDX	N/A	N/A	17.78			
TOTAL			100.00	ABS DENSITY g/cc	N/A	1.61
Moisture	N/A	N/A	0.20			
Ash	N/A	N/A	0.09			
Methylene Cl Solubility	N/A	N/A	31.40			

CLOSED BOMB

	LOT NUMBER	TEMP °F	RQ	RELATIVE FORCE
TEST		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	+90	100.00	100.00%

REMARKS The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700cc bomb with 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

PARAMETER	SPECIFICATION	DIE	FINISHED	STD DIV. in % of Mean Dimensions: SPEC	ACTUAL
LENGTH (L)	N/A	1.60	1.61	N/A	N/A
DIAMETER (D)	N/A	.700	.690	N/A	N/A
PERF. DIA. (d)	N/A	.023	.021		
Web Ave.	N/A	.099	.097		
Outer	N/A	.075	.104		
Middle	N/A	.108	.086		
Inner	N/A	.115	.103		
Web Diff.	N/A	N/A	7.95		
L:D	N/A	2.29	2.33		
D:d	N/A	30.43	28.21		

DATES

- PACKED 1/87
- SAMPLED 1/87
- TEST FINISHED 1/87
- OFFERED
- DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER Carton 327310; Barrier Bag 327041; Wood Box 327311

REMARKS

Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer

D V [signature] [signature]

ARRCOM FORM 914 R 10 AUG 77

PROPELLANT DESCRIPTION SHEET

COMPOSITION: 2R-20 19 Perf Stick	DA LOT NUMBER: HCL87C010-011
SPECIFICATION: Honeywell Multica GPR 087-029	PACKED AMOUNT: 62 Pounds
MFD AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS: B95089; 95091; 95092

NITROGEN CONTENT: MAX ____ %; MIN ____ %; AVG 13.10 %

BI STABEX (65.5°C): ____ MINS; 45+ MINS

STABILITY (134.5°C): ____ MINS; 30+ MINS; EXPLOSION ____ MIN

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F FROM	TO		TIME MINUTES	TIME HOURS
-	-	Blending	20	-
210	215	Differential Rolling	-	140
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION: CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED
NITROCELLULOSE	N/A	N/A	50.64
NITROGLYCERIN	N/A	N/A	11.45
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24
AKARDIT II	N/A	N/A	0.71
MAGNESIUM OXIDE	N/A	N/A	0.05
GRAPHITE	N/A	N/A	0.05
RDX	N/A	N/A	17.78
TOTAL			100.00
Moisture	N/A	N/A	0.20
Ash	N/A	N/A	0.09
Methylene Cl Solubility	N/A	N/A	31.40

STABILITY AND PHYSICAL TESTS: TESTS	FORMULA	ACTUAL
HEAT	cc 40'	cc 60'+
80 FUMES	NF 1 Hr	NF 1 Hr
FORM OF PROPELLANT		Cyl
°ITALIANI	≥1.8 Kg/mm slope at 100mm	.349
BOE cal/gm	N/A	1163
ABS DENSITY g/cc	N/A	1.61

CLOSED BOMB

TEST	LOT NUMBER	TEMP °F	RQ	RELATIVE FORCE
		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	+90	100.00	100.00

REMARKS: The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700cc bomb with 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

PARAMETER	SPECIFICATION	DIE	FINISHED	DIE Div. or % of Mean Dimension: SPEC	ACTUAL
LENGTH (L)	N/A	4.75	4.78	N/A	N/A
DIAMETER (D)	N/A	.700	.686	N/A	.93
PERF. DIA. (d)	N/A	.023	.021		
Web Ave.	N/A	.099	.097	DATES	
Outer	N/A	.074	.090	PACKED 1/87	
Middle	N/A	.107	.100	SAMPLED 1/87	
Inner	N/A	.116	.102	TEST FINISHED 1/87	
Web Diff	N/A	N/A	5.34	OFFERED	
L:D	N/A		6.97	DESCRIPTION SHEETS FORWARDED	
D:d	N/A	30.43	32.15		

TYPE OF PACKING CONTAINER: Carton 327049 ; Barrier Bag 327202 ; Wood Box 327088

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer: D W Shelgren W E Thomas

ARRCOM FORM 214 R 10 AUG 77

PROPELLANT DESCRIPTION SHEET

COMPOSITION: 2R-20 19 Perf Stick	DA LOT NUMBER: HCI87C010-012
SPECIFICATION: Honeywell Multiica CPR 087-029	PACKED AMOUNT: 60 Pounds
MFG AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED LOT NUMBERS: B95089; 95091; 95092

NITROGEN CONTENT: MAX 13.13 %; MIN 13.07 %; AVG 13.10 %

EI STARCH (65.5°C): ____ MIN; ____ MIN; 454 MIN

STABILITY (134.5°C): ____ MIN; ____ MIN; 30+ MIN; EXPLOSION ____ MIN

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F MIN	TEMPERATURE °F MAX		TIME (HRS) MIN	TIME (HRS) MAX
-	-	Blending	20	-
210	215	Differential Rolling	-	140
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION: CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED
NITROCELLULOSE	N/A	N/A	50.64
NITROGLYCERIN	N/A	N/A	11.45
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24
AKARDIT II	N/A	N/A	0.71
MAGNESIUM OXIDE	N/A	N/A	0.05
GRAPHITE	N/A	N/A	0.05
RDX	N/A	N/A	17.78
TOTAL			100.00
Moisture	N/A	N/A	0.20
Ash	N/A	N/A	0.09
Methylene Cl Solubility	N/A	N/A	31.40

STABILITY AND PHYSICAL TESTS: TESTS	FORMULA	ACTUAL
HEAT	cc 40'	cc 60'+
BB FUMES	NF 1 Hr	NF 1 Hr
FORM OF PROPELLANT		Cyl
*TALIANI	≥1.8 Kg/mm	.349
	Slope at 80mm	
ABE cal/gm	N/A	1163
ABE DENSITY g/cc	N/A	1.61

CLOSED BOMB

TEST	LOT NUMBER	TEMP °F	RQ	RELATIVE FORCE
		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	+90	100.00	100.00

REMARKS: The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700cc bomb with 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

PARAMETER	SPECIFICATION	DIE	FINISHED
LENGTH (L)	N/A	2.70	2.71
DIAMETER (D)	N/A	.700	.686
PERF. DIA. (d)	N/A	.023	.021
Web Ave.	N/A	.099	.097
Outer	N/A	.074	.090
Middle	N/A	.107	.100
Inner	N/A	.116	.102
Web Diff.	N/A	N/A	5.34
L:D	N/A	3.86	3.95
D:d	N/A	30.43	32.15

SID DIV. or P. of Major Component

SPEC.	ACTUAL
N/A	N/A
N/A	1.93

DATES
PACKED 1/87
SAMPLED 1/87
TEST FINISHED 1/87
OFFERED
DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Carton 327049 ; Barrier Bag 327202 ; Wood Box 327088

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer: D W Sutphin

W. R. Williams

ARRCOM FORM 214 R 10 AUG 77

PROPELLANT DESCRIPTION SHEET

COMPOSITION: 2R-20 19 Perf Stick	DA LOT NUMBER: HCL87C010-013
SPECIFICATION: Honeywell Mulsica CPR 087- 029	PACKED AMOUNT: 58 Pounds
MFD AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED BLEND NUMBERS: B95089; 95091; 95092

NITROGEN CONTENT	%	BJ STARCH (65.5°C)	STABILITY (134.5°C)	
MAX		min	min	
MIN		min	min	
AVG	13.10	45+ min	30+ min	
		min	EXPLOSION	hrs

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F FROM	TO		TIME (HRS) MINUTES	HRS/DAYS
-	-	Blending	20	-
210	215	Differential Rolling	-	140
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED
NITROCELLULOSE	N/A	N/A	50.64
NITROGLYCERIN	N/A	N/A	11.45
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24
AKARDIT II	N/A	N/A	0.71
MAGNESIUM OXIDE	N/A	N/A	0.05
GRAPHITE	N/A	N/A	0.05
RDX	N/A	N/A	17.78
TOTAL			100.00
Moisture	N/A	N/A	0.20
Ash	N/A	N/A	0.09
Methylene Cl Solubility	N/A	N/A	31.40

STABILITY AND PHYSICAL TESTS

TESTS	FORMULA	ACTUAL
HEAT	cc 40'	cc 60'+
BD FUMES	NF 1 Hr	NF 1 Hr
FORM OF PROPELLANT		Cyl
"VALIANI"	≤1.8 lb/in slope at 100mm	.349
BOE cal/gm	N/A	1163
ABS DENSITY g/cc	N/A	1.61

CLOSED BOMB

	LOT NUMBER	TEMP °F	RQ	RELATIVE VOLUME
TEST		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	+90	100.00	100.00

REMARKS: The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700cc bomb with 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

PARAMETER	SPECIFICATION	DIE	FINISHED	SID Div. or % of Mean Dimension SPEC	ACTUAL
LENGTH (L)	N/A	2.10	2.13	N/A	N/A
DIAMETER (D)	N/A	.700	.686	N/A	1.93
PERF. DIA. (d)	N/A	.023	.021		
Web Ave.	N/A	.099	.097		
Outer	N/A	.074	.090		
Middle	N/A	.107	.100		
Inner	N/A	.116	.102		
Web Diff	N/A	N/A	5.34		
L:D	N/A	3.00	3.10		
D:d	N/A	30.43	32.15		

DATES
PACKED 1/87
SAMPLED 1/87
TEST FINISHED 1/87
OFFERED
DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Carton 327049 ; Barrier Bag 327202 ; Wood Box 327088

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer

D W Shelton

W R Thomas

PROPELLANT DESCRIPTION SHEET

AA 331-M

Composition: 2R-20 19 Perf Stick	DA LOT NUMBER: HCL8T 010-014
SPECIFICATION: Honeywell Hulrica GFR 087- 029	PACKED AMOUNT: 25 Pounds
MFG AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED LOT NUMBERS: B95089; 95C91; 95092

NITROGEN CONTENT		EI STARCH 65.5 °C	STABILITY 134.5 °C
MAX	13.13 %	____ MINS.	____ MINS.
MIN	13.07 %	____ MINS.	____ MINS.
AVG	13.10 %	45+ MINS.	30+ MINS.
		____ MINS.	EXPLOSION ____ MIN

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE °F FROM	TO		TIME MINUTES	TIME HOURS
-	-	Blending	20	-
210	215	Differential Rolling	-	140
145	155	Evenspeed Rolling	-	-
150	160	Extrusion - Carpet Roll	-	-
145	155	Extrusion - Die	-	-
110	110	Annealing	240	-

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION: CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT OBTAINED
NITROCELLULOSE	N/A	N/A	50.64
NITROGLYCERIN	N/A	N/A	11.45
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	19.24
AKARDIT II	N/A	N/A	0.71
MAGNESIUM OXIDE	N/A	N/A	0.05
GRAPHITE	N/A	N/A	0.05
RDX	N/A	N/A	17.78
TOTAL			100.00
Moisture	N/A	N/A	0.20
Ash	N/A	N/A	0.09
Methylene Cl Solubility	N/A	N/A	31.40

STABILITY AND PHYSICAL TESTS: TESTS	FORMULA	ACTUAL
HEAT	cc 40'	cc 60'+
BD FUMES	NF 1 Hr	NF 1 Hr
FORM OF PROPELLANT		Cyl
°TALIANI	21.8 Kg/mm slope at 100mm	.349
BSE cal/gm	N/A	1163
ABS DENSITY g/cc	N/A	1.61

CLOSED BOMB

TEST	LOT NUMBER	TEMP °F	RQ	RELATIVE VOLT
		-40	90.97	101.69
		+90	92.47	103.43
		+145	96.81	104.25
STANDARD	S-231	+90	100.00	100 ±2%

REMARKS: The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700cc bomb with 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS inches

PARAMETER	SPECIFICATION	DIE	FINISHED	% DEV. of Mean Dimension SPEC	% DEV. of Mean Dimension ACTUAL
LENGTH (L)	N/A	1.60	1.61	N/A	N/A
DIAMETER (D)	N/A	.700	.686	N/A	1.93
PERF. DIA. (d)	N/A	.023	.021		
Web Ave.	N/A	.099	.097		
Outer	N/A	.074	.090		
Middle	N/A	.107	.100		
Inner	N/A	.116	.102		
Web Diff.	N/A	N/A	5.34		
L:D	N/A	2.29	2.35		
D:d	N/A	30.43	32.15		

DATES
PACKED 1/87
SAMPLED 1/87
TEST FINISHED 1/87
OFFERED
DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Carton 327049 ; Barrier Bag 327202 ; Wood Box 327088

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer

D W Shulgaster

W. L. Skinner

ARRCOM FORM 214 R 10 AUG 77

PROPELLANT DESCRIPTION SHEET

COMPOSITION: 2R-20 Carpet Roll	DA LOT NUMBER: HCL87B010-015
SPECIFICATION: Honeywell Multica GFR 087-029	PACKED AMOUNT: 55 Pounds
MFD AT: RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER: Honeywell Subcontract 932077

NITROCELLULOSE

ACCEPTED LOT NUMBERS: B95088, 95059, 95060

NITROGEN CONTENT: MAX ____ %; MIN ____ %; AVG 13.11 %

EU STARCH (65.5 °C): ____ MINS; 45+ MINS

STABILITY (134.5 °C): ____ MINS; 30+ MINS; EXPLOSION ____ MIN

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMP °F	TEMP °C		TIME (MIN)	TIME (HOURS)
-	-	Blending	20	-
210	215	Differential Rolling	-	-
145	155	Evenspeed Rolling	-	-
-	-	Extrusion - Carpet Roll	-	-
-	-	Extrusion - Die	-	-
-	-	Annealing	-	-

PROPELLANT COMPOSITION — TESTS OF FINISHED PROPELLANT — STABILITY AND PHYSICAL TESTS

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED
NITROCELLULOSE	N/A	N/A	42.70
NITROGLYCERIN	N/A	N/A	13.12
DIETHYLENE GLYCOL DINITRATE	N/A	N/A	23.16
AKARDIT II	N/A	N/A	0.64
MAGNESIUM OXIDE	N/A	N/A	0.03
GRAPHITE	N/A	N/A	0.05
RDX	N/A	N/A	20.30
TOTAL			100.00
Moisture	N/A	N/A	
Ash	N/A	N/A	0.10

TESTS	FORMULA	ACTUAL
HEAT	cc 40'	cc 60'+
BS FUMES	NF 1 Hr	NF 1 Hr
*TALIANI	81.8 Kg/mm	
	sieve at 100mm	*
BBE cal/gm	N/A	1166
ABS DENSITY g/cc	N/A	1.62
Form of Prop.		Carpet Roll

*Did not reach 100 mm

CLOSED BOMB

	LOT NUMBER	TEMP °F	RQ	RELATIVE FORCE
TEST		-40	102.99	104.97
		+90	118.06	106.86
		+145	121.83	106.92
STANDARD	PE-472-138	+90	100.00	100.00

REMARKS: Closed bomb was shot using carpet roll cut into strips (7.5"x.125"x .090") fired against the 829 standard 700 cc bomb using a 0.1 gm/cc loading density.

PROPELLANT DIMENSIONS (inches)

PARAMETER	SPECIFICATION	DIE	FINISHED	SPEC	ACTUAL
LENGTH (L)	N/A	N/A	4	N/A	N/A
DIAMETER (D)	N/A	N/A	4	N/A	N/A
PERF. DIA. (d)	N/A	N/A	N/A		
L:D	N/A	N/A	1		
D:d	N/A	N/A	N/A		

DATES: PACKED; SAMPLED; TEST FINISHED; OFFERED; DESCRIPTION SHEETS FORWARDED

TYPE OF PACKING CONTAINER: Lever Pack Can

REMARKS: Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.

SIGNATURE OF Development Engineer: D. W. Kirkpatrick

ARRCOM FORM 214 R 10 AUG 77

PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYSTEM
EXEMPT PARA 7-2a
AR 335-15

COMPOSITION: PROPELLANT JA-2 19-PERF HEX GRANULAR

LOT NUMBER: RAD-PD-090-1

SPECIFICATION: DCD-P-64035B; ORDER RELEASE NO. 235-92, 7/7/92

PACKED AMOUNT: 75.5 pounds

MANUFACTURED: RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA 24141

CONTRACT NUMBER: DAAA09-91-2-0001

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	KI STARCH 65.5°C	STABILITY 134.5°C
BB 95539, BB 95540, BB95541	MAX 13.17 %	45+ MINS	30+ MINS
	MIN 13.06	45+ MINS	30 MINS
	AVG 13.13	45+ MINS	30+ MINS
			EXPLOSION HRS

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE, °F		PROCESS - DRYING	TIME	
FROM	TO		DAYS	HOURS
145	155	CARPET ROLL AT EXTRUSION		
160	170	EXTRUSION DIE		
105	115	ANNEAL		6

TEST OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Tests	Formula	Actual
Nitrocellulose	59.50	± 2.00	58.89	Heat test @ 120°C	NCC 60'	CC 60'+
Nitroglycerin	14.90	± 1.00	15.54	No fumes	NF 60'	NF 60'
Diethylene glycol dinitrate	24.80	± 1.50	24.78			
Akardit II	0.70	± 0.20	0.71			
Magnesium oxide	0.05	- 0.02	0.03	HOE (cal/g)	1120 Nom.	1115
Graphite	0.05	- 0.02	0.05	Absolute density, g/cc	1.56 min	1.56
Total	100.00		100.00			
Moisture content	0.5	± 0.3	0.3	Form	hexagonal	hexagonal
Ash content	0.3	MAX	0.1	Number of perfs	19	19
Methylene chloride solubles	40.4	± 3.0	41.4			

CLOSED BOMB

Lot Number	Temp °F	Relative Quickness	Relative Force
PD-090-1	+90	82.7	99.9
STD-71136		100.00	100.00

REMARKS: FIRED IN A 70C CC BOMB AT 0.20 G/CC LOADING DENSITY

PROPELLANT DIMENSIONS (INCHES)

	SPEC	DIE	FINISHED	Uniformity by Std Deviation, % SPEC	Uniformity by Std Deviation, % ACTUAL
LENGTH (in.)	0.75 NOM	---	0.736	6.25 MAX	4.56
O.D. (in.)	0.789 NOM	0.834	0.811	6.25 MAX	0.93
PERF (in.)	0.027 NOM	0.026	0.026		
WEB (avg)	0.109 NOM	---	0.113	Dates	
WEB (inner)	INFO	---	0.120	PACKED 11-92	
WEB (middle)	INFO	---	0.111	SAMPLED 11-92	
WEB (outer)	INFO	---	0.106	TEST FINISHED 12-92	
L/D	INFO	---	0.908	OFFERED 1-93	
D/d	INFO	---	30.69	DESCRIPTION SHEETS FORWARDED	
WEB (diff %)	15 MAX	---	4.04		

TYPE OF PACKING CONTAINER: DOT 21-C FIBER DRUM

REMARKS: THIS DRUM CONTAINED NET PROPELLANT WEIGHT OF 75.5 POUNDS

THIS LOT MEETS SPECIFICATION REQUIREMENTS

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE

D. ZEOLI Danny Zeoli

SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE

C. N. HALL

ARRCOM FORM 216R 10 AUG 77

C:\DESCRPT\090-1.SS

PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYSTEM EXEMPT PARA [illegible] AR 335-[illegible]

COMPOSITION: PROPELLANT JAX-1 19-PERF HEX GRANULAR	LOT NUMBER: RAD-PD-090-2
SPECIFICATION: DOD-P-64035B; ORDER RELEASE NO. 235-92, 7/7/92	PACKED AMOUNT: 92.5 pounds
MANUFACTURED: RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA 24141	CONTRACT NUMBER: DAAA09-91-Z-0001

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
BB 95539, BB95540, BB95541	MAX 13.17%	45+ MINS	30+ MINS
	MIN 13.06	45+ MINS	30 MINS
	AVG 13.13	45+ MINS	30+ MINS
			EXPLOSION HRS

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE, °F		PROCESS - DRYING	TIME	
FROM	TO		DAYS	HOURS
145	155	CARPET ROLL AT EXTRUSION		
160	170	EXTRUSION DIE		
105	115	ANNEAL		6

TEST OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Tests	Formula	Actual
Nitrocellulose	55.33	NOM.	55.73	Heat test @ 120°C	NCC 60'	CC 60'+
Nitroglycerin	13.86	NOM.	14.25	No fumes	NF 60'	NF 60'
Diethylene glycol dinitrate	23.06	NOM.	22.72			
RDX	7.00	NOM.	6.42			
Akardit II	0.65	NOM.	0.74	HOE (cal/g)	Info	1131
Magnesium oxide	0.05	NOM.	0.06	Absolute density, g/cc	Info	1.59
Graphite	0.05	NOM.	0.08			
Total	100.00		100.00	Form	hexagonal	hexagonal
Ash content	0.3	NOM	0.1	Number of perfs	19	19
Methylene chloride solubles	40.4	NOM	42.2			
Moisture content	0.5	NOM	0.3			

CLOSED BOMB

Lot Number	Temp °F	Relative Quickness	Relative Force
RAD-PD-090-2	+90	81.6	101.1
STD-71136		100.00	100.00

REMARKS: FIRED IN A 700 CC BOMB AT 0.20 G/CC LOADING DENSITY

PROPELLANT DIMENSIONS (INCHES)

	SPEC	DIE	FINISHED	Uniformity by Roll Deviation, % SPEC	ACTUAL
LENGTH (in.)	0.75 NOM	---	0.746	---	4.42
O.D. (in.)	0.789 NOM	0.834	0.809	←	0.63
PERF (in.)	0.027 NOM	0.026	0.026		
WEB (avg)	0.109 NOM	---	0.114	Dates	
WEB (inner)	INFO	---	0.123	PACKED 11-92	
WEB (middle)	INFO	---	0.111	SAMPLED 11-92	
WEB (outer)	INFO	---	0.108	TEST FINISHED 12-92	
L/D	INFO	---	0.921	OFFERED 1-93	
D/d	INFO	---	30.94	DESCRIPTION SHEETS FORWARDED	
WEB (diff %)	INFO	---	5.08		

TYPE OF PACKING CONTAINER: DOT 21-C FIBER DRUM

REMARKS: THIS DRUM CONTAINED NET PROPELLANT WEIGHT OF 92.5 POUNDS

THIS LOT MEETS SPECIFICATION REQUIREMENTS

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE	SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE
D. ZEOLI Danny Zeoli	C. N. HALL

ARRCOM FORM 214R 10 AUG 77 Q:\DESCRPT\090-2.

PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYSTEM
EXEMPT PARA [illegible]
AR [illegible]

COMPOSITION: PROPELLANT JAX-I 19-PERF HEX GRANULAR	LOT NUMBER: RAD-PD-090-3
SPECIFICATION: DCE-P-640358; ORDER RELEASE NO. 235-92, 7/[illegible]/93	PACKED AMOUNT: 100 pounds
MANUFACTURED: RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA 24141	CONTRACT NUMBER: DAAA09-91-Z-0001

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	KI STARCH 65.5°C	STABILITY 134.5°C
BB 95539, BB 95540, BB 95541	MAX 13.17%	45+ MINS	[illegible] MINS
	MIN 13.06	45+ MINS	30 MINS
	AVG 13.13	45+ MINS	30+ MINS
			EXPLOSION HRS

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE, °F		PROCESS - DRYING	TIME	
FROM	TO		DAYS	HOURS
145	155	CARPET ROLL AT EXTRUSION		
160	170	EXTRUSION DIE		
105	115	ANNEAL		6

TEST OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Tests	Formula	Actual
Nitrocellulose	51.77	NOM.	54.48	Heat test @ 120°C	NCC 60'	CC 60'+
Nitroglycerin	12.96	NOM.	12.59	No fumes	NF 60'	NF 60'
Diethylene glycol dinitrate	21.58	NOM.	20.07			
RDX	13.00	NOM.	12.10			
Akardit II	0.61	NOM.	0.68	HOE (cal/g)	Info	1144
Magnesium oxide	0.04	NOM.	0.05	Absolute density, g/cc	Info	1.59
Graphite	0.04	NOM.	0.03			
Total	100.00		100.00	Form	hexagonal	hexagonal
Ash content	0.3	NOM	0.1	Number of perfs	19	19
Methylene chloride solubles	40.4	NOM	44.3			
Moisture content	0.5	NOM	0.2			

CLOSED BOMB

Lot Number	Temp °F	Relative Quickness	Relative Force
RAD-PD-090-3	+90	81.1	101.7
STD-71136		100.00	100.00

REMARKS: FIRED IN A 700 CC BOMB AT 0.20 G/CC LOADING DENSITY

PROPELLANT DIMENSIONS (INCHES)

	SPEC	DIE	FINISHED	Uniformity by Std Deviation, % SPEC	ACTUAL
LENGTH (in.)	0.75 NOM	---	0.760	---	1.90
O.D. (in.)	0.789 NOM	0.834	0.810	---	0.70
PERF (in.)	0.027 NOM	0.026	0.027		
WEB (avg.)	0.109 NOM	---	0.114	Dates	
WEB (inner)	INFO	---	0.114	PACKED 11-93	
WEB (middle	INFO	---	0.108	SAMPLED 11-93	
WEB (outer)	INFO	---	0.112	TEST FINISHED 11-93	
L/D	INFO	---	0.938	OFFERED 1-94	
D/d	INFO	---	30.16	DESCRIPTION SHEETS FORWARDED	
WEB (diff %)	INFO	---	3.12		

TYPE OF PACKING CONTAINER: DCT 21-C FIBER DRUM

REMARKS: THIS DRUM CONTAINED NET PROPELLANT WEIGHT OF 100 POUNDS

THIS LOT MEETS SPECIFICATION REQUIREMENTS

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE	SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE
D. ZEOLI Danny Zeoli	C. N. HALL

ARRCOM FORM 214R 10 AUG 77

G:\DESCSHT\090-3.DOC

PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYSTEM
EXEMPT PARA [illegible]
AR 335-[illegible]

COMPOSITION: PROPELLANT JAX-C 19-PERF HEX GRANULAR	LOT NUMBER: RAD-PD-090-4
SPECIFICATION: DOD-P-6403 B; ORDER RELEASE NO. 035-92, [illegible] 92	PACKED AMOUNT: 100 pounds
MANUFACTURED: RADFORD ARMY AMMUNITION PLANT, RADFORD VIRGINIA 24141	CONTRACT NUMBER: DAAA09-91-D-0001

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	KI STARCH 65.5°C	STABILITY 134.5°C
BB 95839, BB 95840, BB 95841	MAX [illegible]	45+ MINS	30+ MINS
	MIN 13.08	45+ MINS	30 MINS
	AVG 13.13	45+ MINS	30+ MINS
			EXPLOSION HRS

MANUFACTURE OF SOLVENTLESS PROPELLANT

TEMPERATURE, °F		PROCESS - DRYING	TIME	
FROM	TO		DAYS	HOURS
145	155	CARPET ROLL AT EXTRUSION		
160	170	EXTRUSION DIE		
105	115	ANNEAL		6

TEST OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Tests	Formula	Actual
Nitrocellulose	48.38	NOM.	46.65	Heat test @ 120°C	NCC 60'	CC 60 +
Nitroglycerin	12.11	NOM.	13.54	No fumes	NF 60'	NF 60'
Diethylene glycol dinitrate	20.16	NOM.	21.60			
RDX	16.70	NOM.	17.42			
Akardit II	0.57	NOM.	0.71	HOE (cal/g)	Info	1156
Magnesium oxide	0.04	NOM.	.03	Absolute density, g/cc	Info	1.60
Graphite	0.04	NOM.	0.05			
Total	100.00		100.00	Form	hexagonal	hexagonal
Ash content	0.3	NOM	0.1	Number of perfs	19	19
Methylene chloride solubles	40.4	NOM	46.7			
Moisture content	0.5	NOM	0.2			

CLOSED BOMB

Lot Number	Temp °F	Relative Quickness	Relative Force
RAD-PD-090-4	+90	79.8	103.1
STD-71136		100.00	100.00

REMARKS: FIRED IN A 700 CC BOMB AT 0.20 G/CC LOADING DENSITY

PROPELLANT DIMENSIONS (INCHES)

	SPEC	DIE	FINISHED	Uniformity by Std Deviation, % SPEC	ACTUAL
LENGTH (in.)	0.75 NOM	---	0.762	---	1.55
O.D. (in.)	0.789 NOM	0.834	0.818	---	3.54
PERF (in.)	0.027 NOM	0.026	0.027		
WEB (avg.	0.109 NOM	---	0.115	Dates	
WEB (inner.	INFO	---	0.110	PACKED 11-92	
WEB (middle.	INFO	---	0.107	SAMPLED 11-92	
WEB outer	INFO	---	0.127	TEST FINISHED 12-92	
L/D	INFO	---	0.932	OFFERED 1-93	
D/d	INFO	---	30.82	DESCRIPTION SHEETS FORWARDED	
WEB (diff %.	INFO	---	6.94		

TYPE OF PACKING CONTAINER: DOT 21-C FIBER DRUM

REMARKS: THIS DRUM CONTAINED NET PROPELLANT WEIGHT OF 100 POUNDS

THIS LOT MEETS SPECIFICATION REQUIREMENTS

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